

XXV. *Bionomic Notes on Butterflies.* By G. B. LONGSTAFF,
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	PAGE
INTRODUCTORY	607
§ 1. SCENTS	608
§ 2. THE COLOURED JUICE EXUDED BY CERTAIN LEPIDOPTERA	622
§ 3. THE TENACITY OF LIFE OF PROTECTED SPECIES	624
§ 4. BUTTERFLIES BEARING MARKS OF THE ATTACKS OF FOES	627
§ 5. EXPERIMENTAL EVIDENCE AS TO THE PALATABILITY OF BUTTERFLIES	629
§ 6. MIMICS IN THE FIELD DECEIVING MAN	631
§ 7. NOTES ON THE FLIGHT OF SUNDRY BUTTERFLIES	635
§ 8. THE SELECTION BY YELLOW BUTTERFLIES OF YELLOW LEAVES AS RESTING-PLACES	640
§ 9. HELIOTROPISM	643
§ 10. "LIST" AND SHADOW	647
§ 11. THE INVERTED ATTITUDE OF LYCÆNIDS AND SOME OTHER BUTTERFLIES	655
§ 12. THE REST-ATTITUDES OF CERTAIN NEOTROPICAL AND ORIENTAL HESPERIDS	660
§ 13. SEASONAL DIMORPHISM IN NEOTROPICAL BUTTERFLIES	662

Introductory.

WHEN travelling in a country new to him it is almost inevitable that an entomologist's time should be chiefly taken up with searching for insects and securing specimens—his temptation is to become "a mere collector." Further, such observations of more scientific value as he finds time to make are but too apt to be isolated, imperfect and inconclusive. Yet something may be done even during a flying visit, and a judicious arrangement of the notes made may provide useful material for further work by the same naturalist, or by a more capable or more fortunately circumstanced observer, following his footsteps.

But it may be objected to such a paper as this, that it is made up of trivial details, that it is loaded with wearisome repetitions, that everybody has long been familiar with the facts brought forward—in short, that it is but a laborious "demonstration of the obvious."* So be it. For the sake of argument these propositions might all be admitted, and yet the time spent in writing the paper, and

* *W. Bateson*, F.R.S., Report of British Association, 1904, p. 577.

even the space occupied by it in the "Transactions" be amply justified.

The immortal work of Lyell, of Darwin and of Wallace was largely built upon seeming trivialities, on facts many of which were "obvious," and therefore to some persons uninteresting. But with what different eyes do we now look upon those same facts, filled as they are with new meaning! Surely present-day naturalists cannot do better than follow humbly in the footsteps of those "old masters"—observe, record and arrange facts—extract and dress the ore ready for some future metallurgist to smelt, so that some future smith may have the wherewithal to forge useful tools or works of art.

Far more experienced observers than the writer have unfortunately lacked the time or the inclination to place their facts on record. Indeed it is one of the saddest things in the history of science that so much knowledge has perished with the gleaners.* Again, though the facts may have been recorded it is surely well that they should be confirmed, even time after time, before hasty inferences are drawn. Yet again, it is surely desirable to find out how far the facts extend, to what species, genera, families; to what degree they are developed; whether they vary in the two sexes, in the individual, the species, the genus; how they are distributed in space and time and season. Lastly, it is just possible that here and there a seemingly small fact, a residual phenomenon of real import, may have hitherto escaped observation, or at any rate may not have been recorded.

With this apology the following somewhat disjointed notes are communicated, notes on observations made for the most part in the West Indies or Ceylon, but some in other lands and some in Devonshire. Previously recorded kindred observations of the author's are referred to in footnotes, and occasionally quoted in full, with a view to focussing, as it were, all the scattered facts, in the hope of illuminating even to a small degree sundry holes and corners in the great mystery of evolution.

§ 1. *Scents*.

It is now four years since Dr. F. A. Dixey drew atten-

* Col. C. T. Bingham's diaries were in my mind when writing this; he died the week after the paper was read!

tion to the scents of certain common British butterflies.* Since then, dealing with South African material, he has confirmed Fritz Müller's important generalisation,† that these scents may be divided into two classes:—(1) those which are presumably attractive, and are found (with few exceptions) in the male insect only; and (2) those which are presumably repulsive, or protective, and are (with very few exceptions) common to both sexes, often strongest in the female. Further, Dr. Dixey has called attention to the fact that the scents of the first class are agreeable to the average human perception, while those of the second class are for the most part disagreeable, or even disgusting.‡

The additional facts that I am now able to supply appear to confirm previous generalisations, though there are a few apparent exceptions which require further elucidation.

One point may here be mentioned. In addition to the scents hereafter dealt with, a "mousy odour" is in several cases recorded; this is not confined to one sex and is met with in butterflies belonging to various families, but only *after death*. This I believe to be a product of decomposition of either the animal juices or the fæces. The odour resembles that of acetamide, and not improbably may be due to that substance, or some compound ammonia.

It will be noticed that in but very few cases have I concerned myself with the special organs which are involved in elaborating or distributing the scents. Moreover, the subject is now so familiar and the number of species known to produce scents perceptible to man is now so large, that it does not seem necessary to give the new evidence in great detail, nor (as a rule) to deal with species in which positive results have not yet been clearly established.

In the present state of our knowledge it seems most convenient to deal with the various species observed in the order of their systematic arrangement in our cabinets.

* *Dixey*, Proc. Ent. Soc. Lond., 1904, pp. lvi-lx.

† *Fritz Müller*, Trans. Ent. Soc. Lond., 1878, pp. 211-221.

‡ *Dixey*, Proc. Ent. Soc. Lond., 1905, pp. liv-lix; *ibid.* 1906, pp. ii-vii. See also *Wood-Mason* and *De Nicéville*, Journ. Asiatic Soc. Bengal, 1886, vol. xv, Part II, No. 4, pp. 343-393. See also *Longstaff*, Ent. Month. Mag. 1905, pp. 112-115; do. Proc. Ent. Soc. Lond., 1905, pp. xxxv-xxxvi; do. Trans. Ent. Soc. Lond., 1905, pp. 137-8.

So far, however, as the facts are available it would appear that, speaking generally, the *Pierinæ* and *Satyrinæ* belong to the first class, or those with attractive scents, whereas the *Danainæ*, *Acræinæ* and *Heliconiinæ* belong to the second, or those with repulsive scents. The *Ithomiinæ*, *Nymphaliniæ*, *Lycænidæ* and *Papilioninæ* contribute to both classes. Of other groups little or nothing is known as regards scents.

NYMPHALIDÆ.

ITHOMIINÆ.

Tithorea megara, Godt. (Trinidad, 1907). Three ♂ had a very distinct, or even strong, scent, which was compared by both Mrs. Longstaff and myself to *Stephanotis*, but I thought that it had in addition a spicy, or dusty element. A ♀ was scentless.

Athesis clearista, Dbl. (Venezuela, 1907). A ♂ had a slight sweet flowery scent, both alive and dead: it appeared to be associated with the brushes on the hind-wings.

Leucothyris victorina, Hew., and *L. phemonoë*, Dbl. (Venezuela, 1907). A ♂ of each of these species had an offensive odour, which in the latter case seemed to be associated with the tufts or brushes on the hind-wings.

DANAINÆ.

Anosia archippus, Fabr. (Jamaica, Tobago, Panama, Venezuela, 1907). 15 ♂, 2 ♀. All had a scent, similar in quality and intensity in both sexes; it is described in my notes as "slight," "moderate," or "strong," and is compared to that of a cockroach, a musk-rat, a rabbit-hutch, or musty dung; in two cases it is qualified as "scarcely unpleasant," and "scarcely disagreeable."

Danaida plexippus, Linn., *genutia*, Cram. (Mátherán, Bombay Presidency, 1908). A ♂ had a slight "musk-rat" odour in the field, none at home though still alive.*

Danaida jamaicensis, Bates (Jamaica, 1907). 2 ♂, 2 ♀. Of the two males the scent is described respectively as "strong rabbit-hutch odour," and "decided odour, ? cockroach, scarcely disagreeable." Of the females it is noted "both with a strong cockroach smell, perceptible next day: my wife, however, described the odour as slightly fusty."

* Compare Longstaff, Trans. Ent. Soc. Lond., 1905, p. 138.

Danaida cresimus, Cramer (Colombia, Venezuela, 1907). Of 2 ♂ it is noted "? very slight pleasant scent"; of a ♀ "strong, ? musk-rat odour when alive."

Tirumala septentrionis, Butl. (Ceylon, 1908). 11 ♂ were examined, 9 of them yielded a scent, noted as "slight," "moderate," or "decided," and described as pleasant or sweet, and in two cases compared (with, however, some hesitation) to clover. In four instances the genital tufts were displayed; certainly in one of these no scent was perceptible (though subsequently detected in the house). In another instance it is noted that the scent was not connected with the "sexual pouch" on the hind-wing.

Seven ♀ were examined: in 6 the result was negative or doubtful; in the other a slight scent was found and compared in the field to *Stephanotis*, but Mrs. Longstaff in the house said "? ginger."

This species is exceptional among Danaines,* having a decidedly agreeable scent, strongest in the ♂.

Danaida chrysippus, Linn. (Ceylon, 1908). Of 2 ♂ one was without scent, in the other the "musk-rat odour" was detected both during life and after death. In 2 ♀ the musk-rat odour was detected in the field but noted as especially strong at home.†

Chittira fumata, Butl., *taprobana*, Feld. (Ceylon, 1908). Out of 4 ♂ and 4 ♀ a scent was noted in 2 of the latter only, described in the field as "a slight musty scent," but on re-examination in the hotel compared to stale tobacco-smoke. In 1904 the results obtained were more positive—"it has the 'acetylene' odour of *Crastia core*, but not so strong and with a difference." ‡

Parantica aglea, Cram., *ceylanica*, Feld. (Ceylon, 1908). A distinct scent was detected in 15 ♂ out of 17, and in 11 ♀ out of 14. In the ♂ the scent varied from "very slight" to "strong," twice indeed it was so strong as to be clearly perceptible when the insect was fluttering in the net. In quality it was in 13 cases compared to acetylene (it being specially noted in one instance as "*not Hamamelis*"); in the other 2 specimens it is described as "acetylene plus cockroach," but these when re-examined in the house were described as "cockroach only," and

* Compare Bingham, "Fauna of British India: Butterflies," vol. i, p. 2.

† Cf. Dixey, Proc. Ent. Soc. Lond., 1906, p. iv.

‡ Longstaff, Trans. Ent. Soc. Lond., 1905, p. 131.

"slightly musty" respectively. In 6 cases in which there was a decided, or even strong, scent in the field, none was detected in the house; in other instances the scent at home was slighter, or even described as "musty," but in one specimen it was compared to sweet hay.

In all the 11 ♀ the scent is compared to acetylene, with the remark in one case "not so pungent as *Euplœa asela*." Two other ♀ specimens were said to have a musty odour.

I am satisfied that in the case of *P. aglea* the scent is more transitory, possibly more volatile, than in the majority of scent-yielding butterflies.

Crastia asela, Moore (Ceylon, 1908). In 32 out of 38 ♂ and in 17 out of 19 ♀ examined a scent was noted in the field. In 4 ♂ and 1 ♀ my notes record that no scent was detected, as regards the others they are silent. Again, it is clearly recorded that on re-examination in the hotel in the case of 13 ♂ and 5 ♀ no scent could be detected, moreover when a scent *was* noted at home it was in the large majority of cases (especially among males) much fainter than it had been in the field.

In both sexes the scent varied considerably in strength: it was I think quite as strong in the females as in the males, though certainly the three instances in which the scent was strong enough to be obvious through the net were all males. In one ♂ the scent was described as "not unpleasant"; in 5 instances—1 ♂, 4 ♀—it is described as pungent and compared to acetic acid. In the case of a ♀ the note is: "strong pungent odour, acetic acid: distinct at home, still pungent (insect alive). The scent adhered to the fingers after pinching."

As in the case of *Parantica* the scent of *Crastia* would appear to be more volatile than in the *Pierinæ* or in *Limnas*.

Having abundant material I made some endeavour to ascertain the source of the scent. In 15 cases it is noted that the ♂ genital tufts were fully everted when the insect was examined, nevertheless in 5 no scent could be detected, although in the others it was more or less strong. There is a special note in one case: "the acetylene odour seemed to come from the tufts," but, on the other hand, in 4 cases it is noted that the scent appeared to come from the wings, in one of these from their upper surface.

I then tried the effect of rapid dismemberment immediately after pinching:—

(a) A ♂ seen on the wing with tufts displayed. It was caught, pinched and the abdomen amputated. The abdomen yielded no scent, but what I may term the *torso* had a slight acetylene scent, which appeared to come from the wings.

(b) A ♂ with the tufts displayed; the amputated abdomen yielded no scent, but the wings a moderate "acetylene" scent.

(c) A ♂ with the acetylene scent: amputation proved that it was certainly not connected with the abdomen.

(d) A ♂ was dismembered: the scent appeared to come from the thorax.

(e) A ♀ with pungent odour was dismembered: the scent appeared to originate in the thorax.

(f) A ♀ was dismembered: the scent appeared to come from either the thorax or the base of the wings.

From these facts I am forced to the conclusion that in *Crastia* and in *Tirumala* the scent—which moreover is common to both sexes—whatever its source may be, is independent of the genital tufts which form such a conspicuous feature. This conclusion is contrary to my first impression—and certainly contrary to the impressions of such an experienced collector as Commander J. J. Walker, R.N.*

Pademna sinhala, Moore (Ceylon, 1908). Two ♂ were examined with the following results:—

(a) Acetylene odour, moderate in the field, slight at home. (b) Moderate acetylene scent in the field, none in the house. It was alive; on pinching it again the tufts were protruded and there was a momentary strong acetylene scent. Of course it does not necessarily follow that the scent emanated from the tufts.

Narmada montana, Feld. (Ceylon, 1908). 5 ♂ all had a strong, or at any rate decided, acetylene odour in the field; at home either no scent at all, or at most a faint musty odour. In one case the strong acetylene odour seemed to come from the upper surface of the body or wings, while there was a suspicion of a sweet scent (compared with some hesitation to sassafras) which

* Compare *Wood-Mason*, Journ. Asiat. Soc. Bengal, 1886, pp. 343-393, quoted by *Dr. Dixey*, Proc. Ent. Soc. Lond., 1906, p. vi. See also *Longstaff*, Trans. Ent. Soc. Lond., 1905, pp. 87, 108.

seemed to come from the tufts. A living ♀ yielded an odour of acetic acid, which persisted slightly after death.

SATYRINÆ.

Calisto zangis, Fabr. (Jamaica, 1907). In 10 ♂, nearly all those examined, there was a scent varying from faint to strong, compared to treacle, chocolate, burnt sugar, or caramel, but in one instance described simply as "aromatic." The ♂ of this species has a very conspicuous brand. Ten ♀ were without scent.

Mycalasis mincus, Linn., f. *polydecta*, Cram. (Ceylon, 1908). In 2 ♂ exposure of the pencils of hairs on the hind-wings produced a strong scent, which I compared to burnt sugar, my wife to "coarse brown sugar," or "treacle."

Ypthima ceylonica, Hew. (Ceylon, 1908). In a few ♂ of this abundant species a very slight scent of chocolate was detected.

ELYMNIINÆ.

Elymnias fraterna, Butl., *undularis*, Dru. (Ceylon, 1908). Four ♂ had an odour resembling that of vanilla-scented chocolate: in one case Mrs. Longstaff compared it to "very strong honey, or coarse brown sugar."

NYMPHALINÆ.

Neptis jumba, Moore (Ceylon, 1908). A faint sweet chocolate scent was detected in a male in the house. A somewhat similar scent was suspected in another male and in a female. On the other hand, no scent was recognised in the much commoner *N. varmona*, Moore.*

Victorina stelenes, Linn. (Jamaica, 1907). Five ♂ appeared to have a slight flowery scent, in one instance suggesting chrysanthemum.

Precis iphita, Cram. (Ceylon, 1908). Two ♂ out of several examined yielded a slight treacly odour. I noted a similar scent in *P. elelia*, Cram., in S. Africa in 1905.†

Cynthia asela, Moore (Ceylon, 1908). Five ♂ out of 8 had a peculiar slight sweet scent, compared at the time to sassafras, or to French-polish.

* Compare Dr. Dixey's results with African species of the genus. Proc. Ent. Soc. Lond., 1906, p. v.

† *Ibid.* p. v.

Dione vanillæ, Linn. (Jamaica, 1907). Of 17 ♂ examined 13 exhibited an odour varying from very faint to very strong: in character this was distinctly disagreeable, and I noted it as "unpleasant," "like cow-dung," or "like asses," but more usually as "like a stable." My wife considered it "unpleasant," or "offensive." Mr. Abell thought it "musky." A single ♂ of the nearly allied *D. juno*, Cram. (Venezuela, 1907), had a slight stable-like odour.

Colænis cillene, Cram. (Jamaica, 1907). In 8 ♂ out of 11 examined there was a scent, decided, but in no case strong. Its character was noted as "peculiar," "sweetish," "pleasant," "distinctly aromatic," "resinous," "drug-like," or "medicinal"; it suggested to me at one time or another tar, Canada-balsam and *pure* carbolic acid, but my wife compared it to ginger, or a mixture of ginger with jasmine. It is evident that this scent puzzled me greatly at the time, but subsequent experience with other scents makes me think that sassafras would probably be the best comparison.

HELICONIINÆ.

Heliconius curyades, Riff. (Trinidad, 1907). Two ♂ were examined; one had a peculiar, rather pleasant, smell, the other none. Two ♀ were also examined, one with a doubtful result, the other had a slight odour like that of the species next mentioned, but it was only perceptible during life.

Heliconius hydarus, Hew. (Trinidad, Tobago, Venezuela, 1907). Eleven ♂ were examined: 3 gave a negative result and 1 was doubtful, but the remaining 7 had a scent which varied from "very slight" to "very strong," and was described as "musty," "like acetylene," or "like hazeline" (*Hamamelis virginica*, Witch-hazel). This last comparison, which struck me as very good, is due to Mr. G. H. Sworder of Cocoa Wattie, Tobago, who was quite familiar with the scent of the butterfly. Eight ♀ were examined, only 1 with negative results; in the other 7 the scent varied from slight to strong, and was described as "disagreeable," "like acetylene," or "like hazeline." In the case of 1 ♂ and 1 ♀ the scent was so strong as to be easily discerned when the butterfly was fluttering in the net.

Five of the above butterflies were captured in Trinidad

on 14 April, 1907, and were examined for scent when their enclosing papers were opened at Oxford on May 6th, or three weeks after death. One of them—*H. euryades*, ♀—had no scent; the others—*H. hydarus*, 3 ♂, 1 ♀—had a slight, but quite decided, scent! Yet, curiously enough, in the case of two of these male *hydarus*, I did not find it possible on the day of capture to be sure that they had any perceptible scent. Finally, when a drawer containing all my black and red *Heliconii* was opened on 15 July, or three months after death, the odour, though faint and evanescent, was distinctly perceptible in spite of the presence of naphthalene!

I have since heard from a professional setter that he had often noticed when setting them that *Heliconii* had a peculiar scent.

Heliconius charithonia, Linn. (Jamaica, 1907). With this species the majority of observations gave negative results, nevertheless in 3 ♂ and 2 ♀ a slight pleasant flowery scent was detected. In one example of each sex this was confirmed by my wife, who described the odour as "sweet."

Euclides aliphera, Godt. (Trinidad, 1907). Three ♂ were examined, 2 with a negative result; the third was noted as having "a strong *Dione* scent," *i. e.* an odour like that of a stable, or of asses. Two ♀ were also examined; they both had decided odours described respectively as:—"peculiar scent, ? acetylene; strong when alive," and as "strong *Dione* scent when living; slight flowery scent when dead."

LYCÆNIDÆ.

Cyaniris singalensis, Felder (Ceylon, 1908). Six out of 8 ♂ had a scent of varying intensity, described in all cases as sweet, once as "luscious," and once as "*Freesia*-like."

Nacaduba atrata, Horsf. (Ceylon, 1908). Two ♂ had a sweet flowery scent, confirmed by Mrs. Longstaff, and in one case compared by her to "very, very faint jasmine."

Lampides elpis, Godt. (Ceylon, 1908). Five ♂, all those examined, had a sweet scent, which in one instance was compared (with some hesitation) to clover.

Lampides lacteata, De Nicév. (Ceylon, 1908). Nine ♂ were examined, all had a distinct smell which was compared to vanilla biscuits, or chocolate sweets.

Lampides celeno, Cram. (Ceylon, 1908). A minority of the numerous ♂ examined had a faint sweet scent.

Catochrysops hanno, Stoll. (Jamaica, Trinidad, Tobago, Colombia, Panama, Venezuela, 1907). One ♂ was noted to have a very strong, sweet, *Freesia*-like scent, but most of my specimens of this tiny butterfly appeared to be odourless.

Polyommatus bæticus, Linn. (Ceylon, 1908). About half of the ♂ examined had a slight scent like that of meadow-sweet.

Polyniphe dumenilii, Godt. (Venezuela, 1907). Ten ♂ of this little black-and-white butterfly gave positive results of a surprising character. In the majority of cases the odour was strong, or even very strong; moreover it was disagreeable; and I compared it to horse-urine, but more usually to pig-styes, or, perhaps more correctly, to pigs! At first it seemed scarcely credible that so small a butterfly could smell so strongly. My only ♀ specimen was odourless.

Rapala lazulina, Moore (Ceylon, 1908). Three males yielded a scent like vanilla biscuits.

Theclopsis tephreus, Hübn. (Venezuela, 1907). A strong peculiar, rather disagreeable odour was detected in a ♂ of this species.

Tmolus cambes, Godm. and Salv. (Venezuela, 1907). I noted in a ♂ a "treacly smell"; Mrs. Longstaff compared it to "coarse brown sugar."

Tmolus pategon, Cram. (Venezuela, 1907). A ♂ had an odour of chocolate.

PAPILIONIDÆ.

PIERINÆ.

Enantia melite, Clerck (Venezuela, 1907). The only specimen taken, a ♂, had a scent like mignonette.

Terias euterpe, Mén. (Jamaica, 1907). I had ample opportunities of studying this very common Jamaican butterfly. Of 21 ♀ taken not one was scented, but 31 out of 39 ♂ indubitably were. Their odour varied from "very slight" to "strong" (17 specimens); my wife described it on various occasions as "a slight pleasant smell," "strong, like syringa," "a very soft gentle smell, might be jasmine," and "very slight, sweet, jasmine or syringa." Mr. A. P. Ponsonby who walked with me one day suggested "gorse."

To my own judgment the scent resembled rather clove-pink, but was still more like pink bind-weed (*Convolvulus arvensis*, Linn.).

Terias delia, Cram. (Jamaica, Panama, Colombia, Venezuela, 1907), and *T. phiale*, Cram. (Venezuela, 1907). Results conflicting, but in the large majority of cases negative.

Terias albula, Cram. (Trinidad, Tobago, Colombia, Venezuela, 1907). Results uniformly negative.

Terias nise, Cram. (Trinidad, Tobago, Panama, Venezuela, 1907). Out of 8 ♂ taken 5 had a scent, varying from very slight to very strong; it was compared to that of pink bind-weed. A slight scent was detected in a ♀ specimen, this was confirmed by Mrs. Longstaff.

Terias messalina, Fabr. (Jamaica, 1907). In 6 ♂ out of 10 a scent was noted; it is described in my notes as "distinct" or "strong," and compared to pink bind-weed and to spice. It is also noted as "distinct from that of *euterpe*, more dusty, less specific," but another specimen "more spicy than bind-weed."

Terias westwoodii, Boisd. (Jamaica, 1907). Only 3 ♂ were taken, all had a scent, described in one case as "spice odour, not quite the same as *euterpe*."

Terias libythea, Fabr. (Ceylon, 1908). In several ♂ specimens—at least five—a faint scent was detected, which I compared to that of *Convolvulus arvensis*.

Terias hecabe, Linn. (Ceylon, 1908). I failed to detect any scent in this common *Terias* or any of its allied forms.

Catophaga parulina, Cram. (Ceylon, 1908). The results of my 1904 observations* were only in part confirmed. In both years the scent was noted in the ♂ only, in 1904 it was described as "like sweet briar, but sweeter and more luscious," whereas in 1908 it was variously described as "sweet," "very sweet, ? *Freesia*," "flowery," "decided Meadow-sweet," "decided *Stephanotis*," "extremely sweet."

Huphina nerissa, Fabr. (Ceylon, 1908). The results of Indian observations † of 1904 were confirmed, many ♂ yielding a distinct sweet-briar scent.

Pieris calydonia, Boisd. (Venezuela, 1907). Three ♂ of this species—all that I captured—had a distinct flowery

* Trans. Ent. Soc. Lond., 1905, pp. 128, 130.

† Loc. cit. pp. 66, 91, 101, 102, 120, 127.

scent, in one case described as "like that of *G. brassicæ*," in another as "somewhat sickly."

Pieris sp.—apparently undescribed—near *sevata*, Feld. (Venezuela, 1907). The only specimen taken, a ♂, had a "faint, sweet, flowery scent."

Leptophobia aripa, Boisd. (Venezuela, 1907). Seven ♂ out of 8 examined, had a distinct or even strong scent, which I compared on various occasions to orange, *Freesia* and mignonette.

Delias eucharis, Drury (Ceylon, 1908). In India during the winter of 1903-4 I observed the scent of this species and compared it to that of *Ganoris rapæ*, or sweet-briar. On that occasion I made sure of the scent in the ♂, and more than suspected its presence in the ♀.*

My more recent experience enables me to speak with greater confidence. Of 18 ♂ examined a scent was detected in 17; in 4 of these the scent was very slight, or indefinable, but in 12 it was strong, or very strong, and compared to that of sweet-briar. Out of 9 ♀ examined in 3 no scent could be detected, but in 6 specimens there was more or less scent, but in no case was it strong; this was described as "sweet," "dusty or musky," and "faint sweet-briar." Mrs. Longstaff said of the last specimen "very slight lemon-verbena; yes, perhaps more like sweet-briar"; but of another specimen she said "it has a little gentle sort of smell, ? ginger, or ? coarse brown sugar."

Daptonoura lycimnia, Cram. (Venezuela, Trinidad, 1907). The 3 ♂ taken all had a strong, sweet, flowery scent, suggesting *Freesia*. Of 3 ♀ one bears the note "rich sweet scent." There is no doubt whatever about the sex of the individual, neither can I suggest by way of explanation that the note really applies to another individual. This is perhaps the most marked of a very few exceptional cases in which a strong agreeable scent has been observed by me in a female Pierine; for some time my own view was that in each such instance I had been deceived—possibly by a neighbouring flower, or by the scent of another butterfly adhering to fingers or forceps. However, in the case of *D. lycimnia* Fritz Müller observed that the ♀ during courting emitted from her genitalia an odour which he described as "rather faint, though quite distinct . . . very different from that emitted by the wings of the male.

* Trans. Ent. Soc. Lond., 1905, pp. 87, 91, 101.

Fritz Müller found the latter "rather faint and often hardly distinguishable."*

Nepheronia ceylanica, Feld. (Ceylon, 1908). The ♂ of this beautiful butterfly has a more or less distinct scent, which I compared to *Freesia*. A ♀ had a similar scent, though slight, which my wife compared to frangipani.

Phæbis agarithe, Boisd. (Tobago, 1907). Of 3 ♂ examined two yielded a scent noted as being "sweet, neither strong nor pleasant."

Callidryas eubule, Linn. (West Indies, Northern coast of S. America, 1907). In no less than 32 out of the 33 ♂ tested a distinct scent was readily perceived, indeed in the great majority of cases it is noted as "strong," twice as "very strong." In quality the scent was agreeable (Mr. Abell termed it "delicious") and was compared to *Stephanotis*, or *Freesia*, but Fritz Müller † termed it musk-like; Miss Murtfeldt "slight violet." ‡ With the 22 ♀ examined the result was very different; in 9 cases it was negative, but in the remaining 13 a scent was detected, which, though usually described as "very slight," or "slight," and never as "strong," was often distinct enough. In quality the scent of the ♀ *eubule* was disagreeable; somewhat sweet, but recalling bad pomade, or rancid butter, or butyric acid (as Dr. Dixey aptly suggested of another butterfly). Fritz Müller described it as "a very strong peculiar odour, in which some volatile acid seemed to predominate."

Catopsilia pomona, Fabr. (Ceylon, 1908). The sweet scent associated with the fringes of the ♂ was confirmed: § this I compared to *Freesia*, or *Stephanotis*. Out of 27 ♀ examined the result was negative in 18, but in the other 9 a slight, usually very slight, sweet scent without other special character was noted.

Catopsilia pyranthe, Linn. (Ceylon, 1908). The number of specimens taken was very much smaller than of *pomona*, but the scent was more easily detected in the ♂, and more decided in the ♀ than in that species. || In both

* Fritz Müller, Trans. Ent. Soc. Lond., 1878, pp. 217, 218.

† Loc. cit. p. 218.

‡ Scudder, "Butterflies of the Eastern United States," vol. ii, p. 1047.

§ Trans. Ent. Soc. Lond., 1905, pp. 121, 122.

|| For previous experience compare Trans. Ent. Soc. Lond., 1905, pp. 101, 109, 118.

sexes the scent was compared to *Stephanotis*, but in the case of one ♂ to *Freesia*, and in one ♀ Mrs. Longstaff thought the odour was "a little bit hair-oily."

Hebomoia australis, Butl. (Ceylon, 1908). Nine ♂, all those examined, had a heavy sweet scent, in most cases strong, in all decided: my wife and I compared it to the flowers of mango, or cinnamon. In 3 ♀ out of 4 there was a similar scent.

Meganostoma cerbera, Feld. (Venezuela, 1907). One out of three ♀ taken is noted as having had "a slight, very sweet scent; ? clover."

Ixias cingalensis, Moore (Ceylon, 1908). The 9 ♂ examined all had a sweet, but only moderately strong scent which reminded me of meadow-scent. Four ♀ were scentless.

PAPILIONINÆ.

Ornithoptera darsius, Gray (Ceylon, 1908). When at Kandy four years previously Mr. W. G. Freedley, junr., told me that the males of this species had a scent like sassafras, but I had no opportunity then of confirming his statement. Every ♂ that I examined during my more recent visit had a scent, some had a strong scent. At first I compared this to cinnamon and to Canada-balsam; to Mrs. Longstaff it suggested rosemary or "rose-scented hair-oil." Later by the kindness of the Apothecaries Company of Colombo I received through the post a sample of the oil of sassafras, so that I made a direct comparison, with the result that the odours of the oil and the butterfly appeared to be almost identical. The ♀ had an odour like musty straw.

Papilio hector, Linn. (Ceylon, 1908). The ♂ has a musty odour.

Papilio aristolochiæ, Fabr. (Ceylon, 1908). Both sexes have an odour like musty hay. In the case of a ♂ specimen there is a note: "decided disagreeable smell: ? like new black net."

Papilio demoleus, Linn., *crithonius*, Cram. (Ceylon, 1908). A smell like fresh straw was detected in one specimen, a ♂, in another (a ♀) there was "a slight peculiar scent in the field: stronger in the house."*

* Compare *Dixey*, Trans. Ent. Soc. Lond., 1906, p. v, as to the scent of the allied *P. demodocus*, Esp.

Papilio polydamas, Linn. (Jamaica, Trinidad, Venezuela, 1907). An odour resembling that of musty hay, or straw, was detected in 2 specimens of each sex. My wife compared the scent to rue.

Papilio eurymedus, Cram. (Venezuela, 1907). A ♂ had a strong musty straw odour.

Papilio æneides, Esp., *gargarus*, Hübn. (Trinidad, 1907). A living ♀ had a smell of musty straw, which persisted after death.

HESPERIIDÆ.

As yet I have never been able to satisfy myself that any of the Skippers are scented. Dr. Dixey, however, once found a very distinct smell of chocolate in a specimen of *Gegenes oeculta*, Trim.* It seems probable that some special manipulation may be requisite to elicit scents in this group.

§ 2. *The Coloured Juice exuded by certain Lepidoptera.*

It has long been known that some butterflies, notably *Danaïnae* and *Acræinae*, yield a copious yellow or green juice on pinching, and this has been commonly associated with the known, or suspected, distastefulness of the insects themselves.† A devoted student of entomology, M. Félix Plateau,‡ has tried to get to the root of the matter by eating, or at any rate chewing, *Abraxas grossulariata* and its larva and pupa. Mr. Marshall has also tried many tasting experiments with South African butterflies.§ The results were in both cases inconclusive. Prof. Poulton thinks that this is only what might have been expected, since we have no right to suppose that a given butterfly tastes the same to us as to an insectivorous bird. It might be added that the likes and dislikes of our domesticated mammals differ from our own. I must confess that no enthusiasm has so far availed to bring me to the point of chewing a butterfly. However, in a few cases I have ventured to taste a minute drop of the yellow liquid, with somewhat unsatisfactory results.

Telchinia violæ, Fabr. (India, 1904). "When injured a

* Dixey, Trans. Ent. Soc. Lond., 1906, p. ii.

† See Dixey, loc. cit. pp. iii, iv, vi, vii.

‡ Mém. de la Soc. Zool. de France, Tome vii, 1894, p. 375, § 7.

§ Trans. Ent. Soc. Lond., 1902, pp. 405-414.

yellow juice exudes; a minute drop of this placed on the tongue tasted somewhat bitter and disagreeable, but the flavour was by no means strong."*

(Ceylon, 1908.) "The yellow juice slightly bitter."

Crastia asela, Moore. In two ♂ the juice was found to be tasteless: in another it had a slight, ? bitter, taste. In 2 ♀ it was noted as "nearly tasteless," "tasteless, or nearly so."

Pademna sinhala, Moore (Ceylon, 1908). The yellowish juice of a ♂ is recorded as "? tasteless."

Isamia midamus, Linn.; *superba*, Herbst (Hong-Kong, 1904). "The yellow juice expressed by pinching has no marked taste."

A yellow juice, similar in appearance, has been noted in certain *Heterocera* believed to be distasteful. I give the instances which have attracted my attention.

Obeidia tigrata, Guén. (Hong-Kong, 1904). A conspicuous day-flying Geometer, allied to our Magpie-moth. Of this my note is: "Has a somewhat slow flight, and on the wing looks like a yellow butterfly; abundant and decidedly gregarious, many flying about one tree in the afternoon. When pinched it exudes a yellow juice having a bitter taste." I do not appear to have examined it for scent, but, whether or no it possesses an evil odour, it has other characteristics of a distasteful species.

Euschema transversa, Walk. (Ceylon, 1908). Of this handsome very slow-flying diurnal Geometer it is noted that it is extremely tenacious of life, but that its yellow juice is tasteless.

Chalcosia venosa, Walk. (Ceylon, 1908). This day-flying moth flutters much about trees (especially *Litsæa zealandica*, N. ab. E.), moving however faster from one tree to another when its flight is somewhat "vapouring." It is tenacious of life, resisting alike pinching and chloroform. It has a peculiar, faint, disagreeable odour, and exudes a yellow juice, the flavour of which still invites investigation.

In contrast to these somewhat ambiguous results is the conspicuous S. African Acridian, *Phymateus leprosus*, Serv.; when touched this emits copiously a dark olive-green very fetid fluid, which when accidentally tasted proved to be both bitter and unpleasant.†

* Longstaff, Trans. Ent. Soc. Lond., 1905, p. 103.

† Trans. Ent. Soc. Lond., 1906, p. 335.

§ 3. *The Tenacity of Life of Protected Species.*

That the *Danainæ* and some other butterflies have unusually tough integuments which enable them to resist injuries such as would rapidly prove fatal to the butterfly of ordinary constitution has been long well known.* So far the undoubted fact rests to a great extent upon general statements, but it has occurred to the writer that it may be capable of approximate numerical expression.

With tropical collectors it is a familiar experience that at the close of the day on opening the paper envelopes to examine their captures many of the butterflies are found to be still living. It is an equally general experience that this is especially frequent in the case of the *Danainæ*.

It has for some time past been my practice to enter in my note-book against the data referring to such long-lived individuals "Ten. Vit." (*tenax vitæ*). During my visit to Ceylon in the early months of 1908, I paid closer attention to the matter than previously, and feel confident that in the large majority of cases where a butterfly survived the first pinching the fact was duly recorded. The converse fact, that the insect was found dead in the envelope, was very rarely noted. Under these circumstances it may be fairly assumed that the numbers given below to measure the tenacity of life are, if anything, somewhat understated.

Some one will doubtless lodge the plausible objection that many of the butterflies in the table are large insects and consequently that they should often survive a pinch, such as proved almost uniformly fatal to smaller species, is only what might have been expected. This objection is disposed of by the fact that such a large butterfly as *Cynthia asela*, Moore, was never (13 specimens) found alive in the paper at the end of the day; the same is true of *Cethosia nietneri*, Feld. (9 specimens), and of the robustly made and swift-flying *Hebomoia australis*, Butl. (13 specimens). Again, *Catopsilia pomona*, Fabr., is a fairly robust butterfly, yet out of 49 specimens 3 only, a ♂ and 2 ♀, were noted as "tenacious of life."

From my note-books and previously published papers I find that this resistance to death has forced itself upon my attention in the case of the following species:—

* See e.g. Poulton, "Essays on Evolution," 1908, pp. 279, 316. Cf. Bingham, loc. cit. p. 2. Also Marshall, Trans. Ent. Soc. Lond., 1902, pp. 322-323.

Isamia midamus, Linn. Hong-Kong, 1904. (MS. notes.)

Crastia amymone, Godt.; f. *kinbergi*, Wallgr. Macao, 1904. (MS. notes.)

Danaida chrysippus, Linn. India, 1903. Noted as resistant to cyanide as well as to pinching. (Trans. Ent. Soc. Lond., 1905, p. 98.)

Parnassius hardwickii, Gray. Himalayas,* 1903. "Delicate looking though it be, it is strangely tenacious of life." (*Ibid.* p. 69.)

Telchinia violæ, Fabr. India, 1904. (*Ibid.* p. 103.)

Chittira fumata, Butl. Ceylon, 1904. (*Ibid.* p. 131.)

Acræa cabira, Hopff. S. Africa, 1905. Noted as resistant to chloroform as well as to pinching. (*Ibid.* 1907, p. 328.)†

Anosia archippus, Fabr. Jamaica, 1907. (*Ibid.* 1908, p. 41.)

Danaida jamaicensis, Bates. Jamaica, 1907. (*Ibid.* p. 41.)

Danaida eresimus, Cram. Venezuela, 1907. (MS. notes.)

Heliconius charithonia, Linn. Jamaica, 1907. (*Ibid.* p. 42.)

Heliconius hydarus, Hew. Venezuela, 1907. (Entom. Month. Mag., 1908, p. 118.)

*Actinote antea*s, Dbl. and H. Venezuela, 1907. (*Ibid.* p. 74.)

An examination of the following list of observations in Ceylon, January to March, 1908, shows, among other things, that whereas $\frac{3}{4}$ of the specimens of *Papilio hector* taken, and $\frac{2}{5}$ of those of *P. aristolochiæ*, are recorded as tenacious of life, this is *not noted of any* of the 9 specimens of *P. polytes*, 5 of *P. moorcanus*, 4 of *P. demoleus*, 3 of *P. terephon*, 7 of *P. erino*, and 14 of *P. agamemnon*.

So far as my observations go there is no difference in the powers of the two sexes of the butterflies here dealt with to resist injuries.

* In the discussion which followed the reading of the paper Dr. Chapman remarked that three or four pinches scarcely availed to kill the common Alpine *Parnassius apollo*, Linn.

† Mr. W. S. Loat, quoted by *Dixey*, Trans. Ent. Soc. Lond., 1903, p. 149, says of *Acræa vinidia*, Hew., on the White Nile, "takes a long time to die when put in the killing-bottle."

DANAINÆ.

	Total specimens taken.	Tenacity of life noted in
<i>Parantica aglea</i> , Cram. ...	31	17
<i>Tirumala septentrionis</i> , Butl. ...	18	9
<i>Pademna sinhala</i> , Moore ...	2	2
<i>Narmada montana</i> , Feld. ...	6	4
<i>Crastia ascla</i> , Moore ...	51	33
„ <i>core</i> , Cram. (Mátherán)...	6	4
<i>Chittira fumata</i> , Butl. ...	8	2
<i>Danaida plexippus</i> , Linn. ...	1	1
„ <i>chrysippus</i> , Linn. ...	4	0

PAPILIONINÆ.

<i>Ornithoptera darsius</i> , Gray ...	9	4
<i>Papilio hector</i> , Linn. ...	8	6
„ <i>aristolochiæ</i> , Fabr. ...	15	9
„ <i>parinda</i> , Moore ...	13	4
„ <i>lankeswara</i> , Moore ...	3	1
„ <i>jason</i> , Esp. ...	3	1
„ <i>teredon</i> , Feld. ...	3	0
„ <i>erino</i> , Fabr. ...	7	0
„ <i>agamemnon</i> , Linn. ...	14	0
„ <i>polytes</i> , Linn. ...	9	0
„ <i>mooreanus</i> , Rothsch. ...	5	0
„ <i>demoleus</i> , Esp. ...	4	0

ACRÆINÆ.

<i>Teuchinia violæ</i> , Fabr. ...	10	3
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NYMPHALINÆ.

<i>Hypolimnias bolina</i> , Linn. ...	9	2
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PIERINÆ.

<i>Delias eucharis</i> , Dru. ...	26	3
<i>Catopsilia pomona</i> , Fabr. ...	45	3

HETEROCERA.

<i>Chalcosia venosa</i> , Walk.* ...	12	4
<i>Nyetemera nigrovenosa</i> , Moore ...	4	2
<i>Euschema transversa</i> , Walk. ...	2	1

* This species is resistant to chloroform.

§ 4. *Butterflies bearing marks of the attacks of foes.*

This very interesting bionomic point we owe almost entirely to Prof. E. B. Poulton, F.R.S., and Mr. Guy A. K. Marshall.* A list of the butterflies presumably injured by enemies noted by me in India comprised 31 specimens of 28 species.† I append further lists, which amply prove Prof. Poulton's statement that such specimens only want looking for. In nearly every case the injury is symmetrical, *i. e.* affecting the corresponding parts of both right and left wings, so that the probability of the injury being the result of damage during flight by branches or thorns is very small.

Neotropical Butterflies (West Indies, Venezuela, etc.), 1907.

Euptychia pharella, Butl. A small symmetrical injury to tips of fore-wings: ? by bird.

Euptychia hesione, Sulz. Symmetrical injury to middle of hind-wings: ? by bird.

Anartia jatrophæ, Linn. A big unilateral injury involving both right wings, noted before capture.

Cystineura dorcas, Fabr. Symmetrical injury to tips of hind-wings.

Didonis biblis, Fabr. ♀. Injury to anal angles of both hind-wings.

Myseelia cyaniris, Hew. Symmetrical injury to hind-wings: ? by bird.

Aganisthos orion, Fabr. Symmetrical injury to hind-wings: ? by lizard.

Colænis cillene, ♂. Nearly symmetrical injury to anal angles of fore-wings.

Colænis cillene, ♂. Symmetrical injury to hind-wings: ? by lizard.

Heliconius charithonia, Linn. ♂. Symmetrical injury to hind-wings.

Thecla togarna, Hew. ♀. Symmetrical injury to hind-wings, involving lobes and tails.

Glutophrissa drusilla, Cram. ♂. Symmetrical injury to both hind-wings: ? by lizard.

* Poulton, "Essays on Evolution," 1908, pp. 270, 281-3, 325, as well as the references there given.

† Trans. Ent. Soc. Lond., 1905, p. 134.

Terias delia, Cram. ♀. Symmetrical injury to hind-wings.

Terias messalina, Fab. ♀. Symmetrical injury to hind-wings.

Ceylon, 1908.

Crastia asela, Moore, ♀, nearly all hind margin of right fore-wing and apex of right hind-wing gone.

Crastia core, Cram. (Mátherán, India). Symmetrical injury to hind-wings.

Narmada montana, Feld. ♂. Symmetrical injury to fore-wings.

Ypthima ceylonica, Hew. Small symmetrical injury to fore-wings: ? by bird.

Melanitis leda, Linn. Symmetrical injury to anal angles of fore-wings: ? by bird.

Neptis varmona, Moore. Symmetrical injury to fore-wings: ? by lizard.

Cethosia nietneri, Feld. ♀. Symmetrical injury to middle of hind-wings.

Cethosia nietneri, ♀. Symmetrical injury to tips of fore-wings.

Cynthia asela, Moore, ♀. Large symmetrical injury to hind-wings: ? by lizard.

Cynthia asela, ♂. Symmetrical injury to hind-wings: ? by bird.

Cirrhochroa cognata, Moore, ♀. Symmetrical injury to hind-wings.

Hypolimnas bolina, Linn. ♀. Symmetrical injury to fore-wings: ? by bird.

Hypolimnas bolina, ♂. Symmetrical injury to tips of fore-wings.

Pyrameis cardui, Linn. ♂. Symmetrical injury to hind-wings: ? by lizard.

Lampides celeno, Cram. ♂. Symmetrical injury involving whole hind-margin of hind-wings and an angular piece of fore-wings: ? by lizard.

Delias eucharis, Dru. ♂. Symmetrical injury to hind-wings.

Catopsilia pomona, Fabr. ♂. ? Two symmetrical bites involving both hind-wings.

Catopsilia pomona, ♀. Symmetrical injury to hind-wings: ? by bird.

Catopsilia pomona, ♂. All four wings symmetrically injured by one small bite: ? by bird.

Ornithoptera darsius, Gray, ♀. Long narrow symmetrical injury to hind-wings: ? by bird.

Papilio agamemnon, Linn. Symmetrical injury to hind-wings: ? by lizard.

Algeria, 1905.

Euchloë belia, Linn. ♀. Very sharply cut snip out of each hind-wing, larger on left: ? by bird.

Ganoris brassicæ, Linn. Caught fluttering about flower-bed close to the ground, had been nearly done for by a (?) bird; nearly the whole of both hind-wings and three-fourths of the fore-wings gone.

Hong-Kong, 1904.

Papilio paris, Linn. Almost symmetrical injury to all four wings, large pieces gone.

§ 5. *Experimental Evidence as to the Palatability of Butterflies.*

The following experiments, conducted at the suggestion of Prof. Poulton, are a small contribution to the mass of facts accumulated by Mr. Guy A. K. Marshall and Mr. Frank Finn.*

At our hotel at Kandy were two Mainas (*Gracula*), talking birds of the Starling family (*Sturnidæ*). These birds, which were very tame, were confined in two fairly roomy cages three or four yards apart. I will call the birds A and B.

19 January, 1908. Bird A was given 5 dead butterflies in the following order:—*Atella phalanta*, *Polyommatus bæticus*, *Loxura arcuata*, *Neptis varmona*, *Telchinia violæ*. The bird gave the *Loxura* a few pecks and then let it alone. The tough integument of the *Telchinia* seemed to give the Maina much trouble, but it showed no evidence of disgust. The other three butterflies were taken greedily, the bird, like Oliver Twist, obviously asking for more. It shook the butterflies as a dog shakes a rat.

* *Marshall*, Trans. Ent. Soc. Lond., 1902, pp. 297-397; *Finn*, Journ. Asiat. Soc. Bengal, LXIV, Pt. ii, 1895, p. 344; LXV, Pt. ii, 1896, pp. 42; LXVI, Pt. ii, 1897, pp. 528, 613, 667-8; quoted by *Poulton*, "Essays on Evolution," 1898, pp. 269, 317. See also *Marshall*, Trans. Ent. Soc. Lond., 1908, pp. 137-142.

21 January, 1908. Bird A appeared to be very anxious to be fed. I gave it a dead *Catopsilia pomona*, ♀, which it pecked to pieces: next a dead *Parantica aglea*, it ate its abdomen: then a dead *Papilio aristolochiæ*, after giving this several pecks it left it and did not touch it again. I then gave it two *Crastia asela*, both alive; the fact of life seemed to interest the bird and it tried each of the specimens twice but then appeared to be disgusted and refused even to look at any of the following, of which dead individuals were put into its cage: *Papilio agamemnon*, *Jamides bochus*, a small Lycaenid (probably either a *Catochrysops* or a *Nacaduba*), *Loxura arcuata* and *Neptis varmona*.

Same day. Gave bird B a dead *Atella phalanta*, which it ate; after this a living *Crastia asela*, it pecked this several times but did not eat it.

23 January, 1908. Bird A was busy preening its feathers and appeared to have just been fed; I could not attract its attention. While thus engaged bird B sought to attract *my* attention, so I gave it in succession dead specimens of:—*Ergolis* sp., *Telchinia violæ*, *Delias eucharis* and *Papilio aristolochiæ*. It gave the two first a few pecks; the *Delias* it pecked once or twice, but it gave the *Papilio* a single peck only. Perhaps it was not hungry.

I then put the last two butterflies into the cage of bird A. It pecked the *Delias* several times, but the *Papilio* only once or twice. After this it declined even to look at the *Papilio* any more, but came to the front of its cage repeating again and again what sounded extremely like "No good! No good!"

2 February, 1908. Gave Maina A a dead *Nissanga patnia* which it appeared to eat.

4 February, 1908. The Mainas had evidently been fed; there was food in their cages and bird A had upset its food.

Gave A an *Ergolis* sp., which it ate.

Gave B a *Nissanga patnia*; it ate it.

Offered a living *Hypolimnias bolina*, ♂, first to one bird, then to the other; each pecked its wing, but no more.

Bird A would not look at *Cirrhochroa cognata*.

I came to the conclusion that the birds were not hungry, and therefore the observations of little value.

- 7 February, 1908. Offered to two young chickens first a *Papilio aristolochiæ* and then a *P. polytes*, ♂. One of them looked at the first-named and then walked away; neither looked at the *polytes*.

The same two butterflies were then offered to Maina A, which pecked at both several times, then wiped its beak and left them.

This day's experiments were considered unsatisfactory at the time; it was nearly 6.0 p.m., and perhaps the birds were sleepy.

- 14 February, 1908. Gave bird A a *Lampides* sp.; it ate it and looked about for more.
- 15 February, 1908. Gave bird A 2 *Ypthima ceylonica* and 1 *Lampides* sp.; it ate them all three. A *Neptis varmona* was then offered to the same bird, which gave it but one peck. The *Neptis* was then offered to bird B, which also gave it one peck.
- 16 February, 1908. Gave to bird A three butterflies, *Lampides* sp., another Lycaenid (species not noted), and a *Nissanga patnia*: it ate them all up completely. Another specimen of the *Nissanga* was swallowed at the second attempt. An *Ergolis* sp. was also eaten and swallowed. I then offered the same bird a *Papilio aristolochiæ*, this after a peck or two was left. The same specimen was then offered to bird B, which would not touch it. It was then handed back to bird A, which gave it another peck and again left it.

So far as these experiments teach anything, it would appear that these Mainas would eat with relish *Nissanga patnia*, *Ypthima ceylonica*, *Atella phalanta*, *Ergolis* sp., and *Lampides* sp.

On the other hand, *Papilio aristolochiæ* and *Crastia asela* were distinctly distasteful.

The evidence as to the other species experimented with fails to convince me one way or the other.

§ 6. *Mimics in the Field deceiving Man.*

It may not be without interest to record a number of cases in which a collector with defective eyesight has

actually been deceived (at any rate momentarily) by Mimics in the field.*

Benares, 30 November, 1903. When I first captured *Hypolimnas misippus*, ♀, I believed it to be a variety of *Danaida chrysippus*, and I think it probable that other specimens were passed over, as ♂ were very common.†

Anantápúr, February, 1904. This note was made:—
“Several times saw the ♂ *H. misippus*, reconnoitring *D. chrysippus*, as if in doubt as to its identity.” ‡

Malakand, 29 October, 1903. The ♀ *Argynnis niphe* flying about flowers was noticed to resemble *Danaida genutia*, which was in abundance at the same flowers, though in this case there was no actual deception. §

Konúr, Nilgiris, February, 1904. “On one occasion I watched a ♀ of *Argynnis niphe*, under the impression that it was *Limnas chrysippus*! The resemblance on the wing is greater than might be supposed.” ||

Horton Plains, Ceylon, 23 March, 1904. “*Argynnis niphe* . . . the ♀ on the wing looking very like *Limnas chrysippus*.” ¶

Hatton, Ceylon, March, 1908. The following extracts from my note-book point to the striking difference in the general look of the two sexes of *A. niphe* when on the wing:—

“a ♀, captured as *Limnas chrysippus*.”

“a ♂, looked like a fritillary.”

I would urge strongly that the resemblance of model to mimic may be much closer in the field than in the cabinet.

Báliganj, Calcutta, 5 December, 1903. “The ♀ *Elymnias undularis*, Dru., is a very fair mimic of *Danaida genutia* but its flight is weaker.” **

Kandy, 9 February, 1908. A tattered ♀ of *Elymnias fraterna*, Butl., was taken for a tattered *Danaida chrysippus*.

* In addition to the disadvantages inseparable from the loss of the sight of one eye, the writer is both myopic and astigmatic; his astigmatism being only in small part capable of correction by optical means.

† Trans. Ent. Soc. Lond., 1905, p. 84.

‡ *Loc. cit.* p. 109.

§ *Loc. cit.* p. 74.

|| *Loc. cit.* p. 113.

¶ *Loc. cit.* p. 132.

** *Loc. cit.* p. 89.

Haragáma, Ceylon, 13 February, 1908. A ♀ *Nepheronia ceylonica*, Feld., on a *Lantana* flower, was taken for *Parantica aglea*.

Durban, S. Africa, August, 1905. *Acræa encedon*, Linn., a somewhat feeble insect with slow flight, was, in spite of its small size, twice momentarily believed to be *D. chrysippus*, which was seen in the same spots on the same days. On the other hand, a small ♀ *D. chrysippus* was actually mistaken for *A. encedon*.*

Durban, August, 1905. "Of *Belenois thysa*, Hopff., we took two ♂; when on the wing they were very like the ♂ of *Mylothris agathina*, Cram., in flight and general aspect. Indeed as seen in the net the *Belenois* so closely mimics the *Mylothris* that one of us, though specially on the look out, was completely deceived, and this even when the two insects were taken the same morning." †

Durban, August, 1908. "... the curious Geometer *Cartaletis libyssa*, Hopff., of which several were seen, but only one taken. It flies rather high, with feeble fluttering action, and when on the wing somewhat recalls *Limnas chrysippus*." ‡

Kandy, March, 1904. "Of the tail-less *Papilio lankeswara*, Moore, f. *dissimilis*, Linn. (the pale form), I took three, but probably saw more since it so very closely mimics *Tirumala limniace*, or a large *Parantica ceylonica* (*aglea*), as easily to pass for one of those insects; it is indeed most easily distinguished from them by its habit of fluttering while feeding upon a flower." §

Near Peradeniya, Ceylon, 29 January, 1908. I was with that experienced and keen-eyed entomologist, Mr. E. E. Green, when he netted a *P. lankeswara*, f. *dissimilis*, under the impression that he was catching *Tirumala septentrionis*, Butl.

Kandy, 2 March, 1908. I myself took a ♀ *P. dissimilis* which I imagined to be *Tirumala septentrionis* as it flew past.

Haragáma, Ceylon, 18 February, 1908. Took a ♀ *P. lankeswara*, f. *clytia*, Linn. (the dark form), believing it to

* Trans. Ent. Soc. Lond., 1907, pp. 318, 321, 328.

† Loc. cit. p. 325.

‡ Loc. cit. p. 327.

§ Trans. Ent. Soc. Lond., 1905, p. 124.

be *Crastia asela*, Moore. This dimorphic mimicry is very remarkable.

Mortehoe, Devon, July, 1902. The first specimen of *Egeria crabroniformis*, Lewin, that I ever saw alive was at rest on the trunk of a black poplar. Under the idea that it was a hornet I knocked it down and put my foot on it before discovering my mistake.*

Kandy, 21 February, 1908. A specimen of the Clearwing, *Melittia chalciformis*, Fabr., seen hovering over a flower was first thought to be a *Bombylius*, then a Skipper. It distinctly hummed in the net. This instance is quoted to show that the moth, though not suggesting a protected insect, certainly deceived the observer.

Simon's Town, S. Africa, 3 October, 1905. I had much difficulty in distinguishing during life some flies—? *Psoas* sp., and *Prorachthas* sp.—which closely mimicked certain small black, white-ringed Bees, *Halictus albofasciatus*, Smith, ♂, which buried themselves in the flowers of a large *Mesembryanthemum*. In the cabinet the insects look distinct enough, but during life the resemblance, especially in their movements and habits, was very striking.†

Mátherán, W. Gháts, 1908. At the end of March, in a time of extreme drought, insects of various orders were, naturally enough, attracted to such pools as were left about the nearly exhausted springs. Among the visitors were many long-waisted wasps of which I secured a fair number, belonging, as I supposed on a cursory glance, to several species. When Mr. A. H. Hamm had set these for me at Oxford, he remarked, "I see that you have taken a lot of *Conops* along with the wasps that they mimic." Critical examination revealed: HYMENOPTERA:—*Eumenes* ? *arcuatus*, 3; *Eumenes* sp., 1; *Polistes* ? *stigma*, 3; *Icaria* ? *ferruginea*, 1. DIPTERA:—*Ceria eumenoides*, 7; *Conops* sp., 3.

Mortehoe, Devon, August, 1908. Two specimens of the common British Conopid fly, *Physocephala rufipes*, Fabr., suggested to me when alive a *Trochilium* (Clear-wing moth) rather than a wasp.

* Entom. Month. Mag., 1903, p. 196.

† Trans. Ent. Soc. Lond., 1907, p. 380.

Mortehoe, 25 August, 1908. The Syrphid fly, *Chilosia illustrata*, Harr., is common, sometimes abundant, at Mortehoe on the flowers of Ragwort, *Heracleum*, *Angelica*, etc., where it mimics *Bombus sylvarum*, Linn., and the more local *Anthophora furcata*, Panz., sufficiently closely to have deceived for the moment such an experienced hymenopterist as Dr. H. Swale.

Of course we can form but a very imperfect idea of the sense impressions of the lower animals. We know by their actions that hawks see their prey from a considerable distance. The phenomena of mimicry compel the inference that insectivorous birds, and possibly lizards, appreciate comparatively minute differences of shape and colour, yet it is quite conceivable that they cannot distinguish these at a greater distance than a myopic man. We know even less about the sense impressions of insects, in spite of the patient observations of Forel and Lubbock, and the brilliant experiment of Exner. The whole subject is discussed in detail by Dr. Auguste Forel, who seems to have established the fact that insects have a very keen perception of movement—possibly far more acute than their sense of form and colour.* It has often occurred to me when collecting butterflies that it is just possible that they can smell a collector as far as they can see him.

§ 7. *Notes on the flight of sundry Butterflies.*

Too many systematic works deal with insects as mere cabinet specimens, though there are notable exceptions. Not the least valuable part of the late Mr. C. G. Barrett's great work on the "Lepidoptera of the British Islands" is his vivid description of their habits and flight. Again in Moore's "Lepidoptera of Ceylon" the short notes on the mode of flight of many species supplied by Capt. H. Wade-Dalton, Mr. F. M. Mackwood and more frequently Capt. F. S. Hutchison are of great interest. The value of the notes in the last-named work is not diminished by the fact that the observers are not always agreed. The habits of the sexes are usually different; the time of day, not to speak of the weather, greatly affects their flight; probably the time that has elapsed since emergence from the pupa is

* Forel, "The Senses of Insects." Translated by Macleod Yearsley, 1908, *passim*.

another important factor. Hence it follows that hasty generalisations based on the most accurately recorded observations may be most misleading if the qualifying circumstances be left out of account.

The first fact that I would emphasise is the rapid flight of the Whites and Yellows.* That Pierines may be seen fluttering slowly about flowers is true enough,—*e.g.* that *Colias edusa* is not always difficult to catch. Nevertheless Pierines have a knack of flying straight on, as if bound to reach some distant place at a definite time, in a way that Satyrines certainly are not given to. Again, though the Nymphaline may go off at a great pace for a short distance, it usually soon returns to its beat. Among many swiftly flying Pierines that I have come across, are:—*Catopsilia* and the allied genera *Callidryas*† and *Gonepteryx*; the Neotropical *Glutophrissa drusilla*, Cram., and more especially *Pieris phileta*, Fabr.‡; the powerful Oriental *Hebomoia*§; again *Ixias pyrene*, Linn.,|| though not equal to the last named, is a swift flier, as are also many of the *Teraeoli*, notably the South African *T. eris*, Klug.¶

Commander J. J. Walker, R.N., writing of *Euehloë belemia*, Esp., at Gibraltar, Tangier, etc., said: "It has a very strong, swift, and erratic flight, and is by no means easy to catch."** Even the little *Terias*, which seems to go slowly, will be found to move so fast that a large proportion get away, though in this instance the mode of escape is commonly to dart downwards so that the net passes over it, and to the annoyance of the collector the fly rises from the ground.†† There seems to me to be practically no doubt that the swift flight of the Whites and Yellows is due to their exceptional conspicuousness as compared with other butterflies. That they are exceptionally conspicuous is obvious enough.

But not all Pierines are rapid fliers; there are marked and significant exceptions. Thus, many years ago, Mr. A. R. Wallace,‡‡ writing of the Oriental genus *Thyca* (*Delias*), said: "They have a very slow and weak mode of

* Trans. Ent. Soc. Lond., 1905, pp. 67, 75, 76, 112.

† *Ibid.* 1908, p. 55.

‡ *Ibid.* 1908, p. 49.

§ *Ibid.* 1905, pp. 116, 126, and subsequent experience in Ceylon,

|| *Ibid.* 1905, p. 79. Also MS. notes in Ceylon, 1908.

¶ *Ibid.* 1907, p. 352.

** *Ibid.* 1907, p. 48.

†† *Ibid.* 1890, p. 369.

‡‡ *Ibid.* 1865-8, p. 309.

flight." Again at East London Dr. Dixey* called my attention to the 'slow, fearless, fluttering flight' of *Mylothris agathina*, Cram. Both *Delias* and *Mylothris* furnish well-known models, closely mimicked by other Pierines. Dr. Dixey noted that the flight of the mimic *Belenois thysa*, Hopff., closely resembled that of its model *Mylothris agathina*, but Mr. E. E. Green tells me that *Prioneris sita*, Feld., a very close mimic of *Delias eucharis*, Cram., is a swift flier.

Probably belonging to a different category are two smaller Pierines of dissimilar structure, but similar appearance, the Palæarctic *Leucophasia sinapis*, Linn., and the Oriental *Nychitona xiphia*, Fabr.,† which are among the very feeblest fliers of my acquaintance.

The slow gliding, floating (Hutchison), or skimming flight of certain Nymphalines such as *Neptis*, *Rahinda*, *Ergolis* and *Eurytela* is well known to tropical collectors, what its significance may be I know not. My experiments indicate that *Ergolis* is palatable.‡

It has not been my good fortune to capture that fine butterfly *Parthenos cyaneus*, Moore, but at Kandy I watched its tantalising movements for some time as it flew to and fro far above my longest net-stick. Messrs. De Nicéville and Manders say of this species:—"not rare, but is difficult to catch. It has a remarkably distinctive mode of flight, which makes it recognisable at once on the wing."§ As those gentlemen make no endeavour to describe its peculiarity I will do my best to do so. The wings appear to be seldom raised much above the horizontal, but at comparatively long intervals they are strongly depressed with a jerk, the fly then gliding along for two or three yards. In marked contrast to this is the flight of *Papilio parinda*, Moore, which is attended with obvious flapping in which the wings are much raised but not appreciably depressed below the horizontal. I am glad to be able to add that Mr. E. E. Green agrees with the general accuracy of this description.

The slow heavy flight of the Danaines is of course familiar; I might specially mention *Crastia asela*, Moore, *Narmada montana*, Feld., *Chittira fumata*, Butl., and *Parantica aglea*, Cram. I am not aware that the peculiar dancing

* Trans. Ent. Soc. Lond., 1907, pp. 314, 325.

† *Ibid.* 1905, p. 79. Also Ceylon, 1908. ‡ *Supra*, pp. 124, 125.

§ Journ. Asiatic Soc. of Bengal, vol. lxviii, 1899, p. 188.

movement—up and down—of the two last-named has been placed on record: yet it is often so marked as to enable one to diagnose the insects at a considerable distance. At Kandy late in the afternoon, when other butterflies were getting scarce, *P. aglea* might often be seen slowly dancing about in all directions.

At the falls of the Zambesi I noted *Papilio leonidas*, Fabr., as flying slowly “with the manner of a Danaid”; this made me suspect it to be a mimic, as I afterwards found to be the case.* Mr. Marshall, who is quite familiar with the insect, whereas I have seen but very few specimens, speaks of *P. leonidas* as having a strong and rapid flight, and always going straight ahead.† I think there must have been some special circumstance that caused my specimens to behave in an unusual manner. Certainly its alleged model, *Tirumala petiverana*, did not put in an appearance.

The flight of *Cethosia nietneri*, Feld., another Ceylon butterfly, is I think about the slowest and feeblest that I have observed, and this alike whether it be high up or near the ground. (MS. notes.) The S. African Nymphaline *Salamis anacardii*, Linn., is another remarkably slow flier.‡

As a general rule tropical butterflies seem harder to catch than British. Certainly this is not entirely to be explained by the heat, nor even by swiftness of flight. The slow-flying *Mycalesis* seldom moves far, and is for that very reason hard to catch as it seldom gets quite clear of the herbage amongst which it is found. Again *Elymnias* often refuses to move more than two or three yards when disturbed, yet is hard to catch because it will not get clear of the bushes in the middle of which it loves to flutter. A very different butterfly, the lovely blue *Nepheronia ceylanica*, Felder, a quick flyer, often takes refuge in bushes when pursued; *Teracolus puellaris*, Butl., has a similar habit. *Belenois mesentina*, Cram., and the two common Indian species of *Ixias* seem to spend much of their time flying through and through thorn bushes.§

Three years ago || I called attention to the curious habit of the ♂ *Catopaga paulina*, Cram., of flying in strings as though tied together by an invisible thread. I witnessed this

* Trans. Ent. Soc. Lond., 1907, p. 359.

† *Ibid.* 1902, p. 507.

‡ *Ibid.* 1906, p. 114; also *Ibid.* 1907, pp. 321, 322, 325.

§ *Ibid.* 1905, pp. 75, 80, 89. || *Ibid.* p. 130.

again at Haragáma, Ceylon, 20 January, 1908. Soon after mid-day large numbers of the ♂ were seen flying down the bed of the stream, sometimes in ones and twos, but often 3, 4 or 5 together in strings. On the same day clusters of a score or more were seen drinking at wet sand; when disturbed they would quickly come back to the favoured spots, as many as 5 to 7 together, in strings, all conforming to the movements of their leader like wild geese.

Melanitis leda, Linn., is an insect with which I have been unfortunate, never having come across it in any numbers. At the beginning of February 1908, I twice witnessed its evening flight—at about 6:30 p.m. when it was nearly dark. My net-stick consists of two lower joints of a salmon-rod; on the occasion referred to the butt-joint, which is partly covered with cork, was lying near me on the ground. The butterfly flew in jerks, making short circuits and returning again and again to settle on my hat, my net, or the net-stick on the ground. It struck me at the time that it might probably be guided by the sense of smell, especially as it selected the part of my net-stick that was most handled. Yet it is quite possible that the butterfly was attracted by my white tropical clothing, and by the light colour of the cork, which was fairly conspicuous in the increasing gloom under the palms. One evening when strolling in the hotel garden alone in search of *leda* a leaf of a coco-nut palm fell close to me with a positive crash; when one considers that it measured between 11 and 12 feet long it can be understood that I was not a little startled.

The Ceylon *Papilio*s would appear to be more easily netted in the afternoon than in the morning; this is especially the case with *Ornithoptera darsius*, Gray, and *P. parinda*, Moore.

P. demoleus, Linn., is swift of flight; so is *P. agamemnon*, Linn., which has a darting movement. The last-named is quite an inconspicuous butterfly whether on the wing or at rest, affording a marked contrast to the glorious *P. erino*, Fabr., which is almost startling in its brilliance.

The flight of *P. hector*, Linn., is not especially swift, but is marked by the straightness of its course, seeming to keep on one level. Its black, white and scarlet colouring is very obvious in flight, and the strong contrast of colours seems to make the movement of its wings more obvious and more rapid in appearance.

In marked contrast with the last is *P. aristolochiæ*, Fabr., which sails about slowly and quietly with little obvious flapping of the wings; it moves about in a stately way as if confident in its immunity from attack and is the most easily caught of all the group.

P. polytes, Linn., two of whose polymorphic ♀ mimic *hector* and *aristolochiæ* respectively, behaves very differently from them and seems to trust much to swiftness of flight; my observations chiefly relate to the ♂, and I have an impression that the flight of the ♀ is slower, but this requires confirmation. Though well known to Indian entomologists I am not aware that the contrast in flight between *polytes* and *aristolochiæ* has yet been placed on record.

It is a notable habit with many *Papilios* that when settled on flowers feeding they keep their wings in almost constant movement.* This has been noted in all the following species:—*O. darsius*; this when feeding occasionally stops fluttering, dropping the fore-wings back (towards the abdomen); *P. parinda*, *P. hector*, *P. aristolochiæ*, *P. polytes*, *P. agamemnon* (the habit is very marked in this species), *P. demoleus*, *P. demodocus*, *P. dissimilis* and *P. mooreanus*, Rothsch. (a race of *helenus*, Linn.).

I was much struck by specimens of the last-named in the forest at Hatton, Ceylon (5 March, 1908), settled on very dark grey rocks drinking, with their wings about $\frac{3}{4}$ expanded, but with the fore-wings drawn back so as almost entirely to conceal the conspicuous cream-coloured spot on the hind-wings. For the moment I thought that there was before me some other species, entirely black on the upper side.

P. teredon, Feld. (*sarpedon*, Linn.), and *P. jason*, Esp. (*telephus*, Feld.), do not flutter when drinking.

§ 8. *The selection as resting-places of Yellow Leaves by Yellow Butterflies.*

As there still appear to be entomologists of wide experience who doubt whether butterflies, impelled by instinct, ever select resting-places of like colour with themselves,

* Longstaff, "Some Rest Attitudes of Butterflies," Trans. Ent. Soc. Lond., 1906, p. 111.

it seems worth while to bring together the following observations.*

It is a singular coincidence that on passing through the garden of the University of Bombay, 22 March, 1908, I again saw a *Catopsilia* and watched it settle on a shrub: this was not a yellow-leaved plant, as on the former occasion, but its leaves varied a good deal in colour and the butterfly settled on the *yellowest*: it was certainly much less conspicuous than it would have been on the greenest leaf: a German fellow-traveller whose attention I called to the butterfly agreed as to the partial concealment by the similarity in colour.

Barbados, 18 December, 1906. A ♀ of *Callidryas eubule*, Linn., was seen, when a cloud passed over the sun, to flutter about some herbage for a short time, as though looking for something, and finally to settle on a yellow leaf of the "Life Plant," *Bryophyllum calycinum*, Salisb.

Constant Spring, Jamaica, 8 January, 1907. Two specimens of *C. eubule* (sex not recorded) were seen when the sky was dull to settle on the lower, yellowish leaves of *Plumbago scandens*, Linn., close to the ground.

Mackfield, Jamaica, 27 January, 1907. I was watching the movements of a ♂ *C. eubule*, when a cloud passed over the sun; after fluttering about for a very short time it settled in the middle of a yellow, lower leaf of the *Bryophyllum*.

Montego Bay, Jamaica, 4 February, 1907. A ♀ *C. eubule* was seen flying across the race-course. The track was carpeted with short grass of a rich full green, but amongst the grass were long trailing stems of the *Ipomœa pes-capræ*, Sw.; on one of these stems was a solitary bright yellow leaf, far from any other of like colour, on this the yellow butterfly settled.

Montego Bay, Jamaica, same day. A ♀ *C. eubule* was seen to settle on an isolated yellow leaf of a creeper in a hedge, about 6 feet from the ground, all the surrounding foliage being green.

* See Longstaff, Trans. Ent. Soc. Lond., 1906, pp. 113-118. Also Dixey, Proc. Ent. Soc. Lond., 1906, p. xxix, who, in the discussion following the reading of the paper first quoted, gave several interesting instances from various authors. Also Hamm, Proc. Ent. Soc. Lond., 1904, p. lxxv; 1905, pp. lxxiii-lxxvi; 1906, pp. c, ci.

Constant Spring, Jamaica, 4 January, 1907. A dull afternoon: a ♀ *Terias euterpe*, Mén., was seen to settle close to a leaf of its own size, shape and colour. Same place and day. A ♂ *T. euterpe* was watched for some time and repeatedly disturbed; it seemed to avoid dark green foliage, and always settled on a low plant with yellow-green leaves.

Mackfield, Jamaica, 27 January 1907; 4.30 p.m. A specimen of *T. euterpe* seen to settle four times as follows:—

- (1) On a yellowish leaf of *Bryophyllum*: it was, however but ill-concealed thereby.
- (2) On a pale green leaf.
- (3) On a yellowish-green, finely-cut fern (*Adiantum* sp.).
- (4) On a yellow-green leaf of a *Convolvulus* (or perhaps *Ipomoea*). In this case the concealment of the insect was remarkable.

Same place and day. Another specimen of *T. euterpe* was seen to settle on the under side of a yellowish leaf of the *Bryophyllum*.

Same place and day. A ♀ of *T. euterpe* was seen to settle three times:—

- (1) On a yellow leaf of *Bryophyllum*; fairly cryptic.
- (2) On a light green leaf of an unknown plant, somewhat cryptic.
- (3) On a leaf of *Bryophyllum* less yellow than (1), the result less cryptic.

Mackfield, Jamaica, 31 January, 1907. Three specimens of *T. euterpe* (sex not determined and specimens not preserved) were watched with the following results respectively:—

- (1) Seen to settle on a yellow leaf of *Bryophyllum*.
- (2) Seen to settle three times, twice being on yellow leaves of *Bryophyllum*.
- (3) Seen to settle seven times. Twice on yellow leaves of *Bryophyllum* (in one case it was *very* well concealed); twice on a yellow fern (? *Polypodium* sp.); one other time it was well concealed, but the plant not noted; on two occasions it was less well concealed.

Constant Spring, Jamaica, 1 January, 1907. A ♀ of *Terias* (? *clathea*, Cram.) was seen to settle in the shade on a leaf of the same colour as the under-side of its hind-wings.

Haragáma, Ceylon, 13 February, 1908. I watched a specimen of *Ixias pyrene*, Linn., f. *cingalensis*, Moore, a ♀, settle three times upon the yellowish leaves of the same (now) widely distributed *Bryophyllum*.*

It should be noted that the faded leaves of the *Bryophyllum* have their margins tinted a purplish-red, resembling in colour the markings found on the under side of dry-season specimens of *Callidryas eubule* and *Ixias pyrene*.

With such facts before me I cannot but believe that the butterflies in question instinctively sought out leaves more or less closely resembling themselves in colour, with a view to concealment.† Undoubtedly the most conspicuous butterflies on the wing are "Whites" and "Yellows." On the move they are protected by their extremely rapid flight, but when at rest they stand in need of special protection. Many of these butterflies are restless and rarely settle, except to feed on flowers, to drink at damp places, or in the case of females to oviposit. To see them go to rest requires both time and patience; the best way being to watch them the moment that a cloud passes over the sun. I have very little doubt that our own Brimstone and Clouded-yellows if watched patiently will be found to seek out yellow resting-places.‡

§ 9. *Heliotropism*.

In a paper read before this Society in March 1906,§ I laid stress upon the habit of many butterflies, when settling in the sunshine, and—when not interfered with by wind or the exigencies of getting food—placing themselves with expanded wings and with their tails turned

* It is perhaps worth recording that at Kandy, in the spring of 1908, the ♂ of *Catopsilia pomona* was on dull days several times beaten out of *Tithonia diversiflora*, a tall, rank-growing, yellow-flowered Composite, said to have been recently introduced into Ceylon from Mexico, and now spreading rapidly. The butterfly seemed to rest among the leaves near the tops of the shoots, but I was not able actually to see it at rest.

† Compare Mrs. Barber's observation on the care exercised by *Papilio dardanus*, a ♂, in selecting a suitable resting-place. *Trimen*, South African Butterflies, vol. iii, p. 254. Quoted by *Marshall*, *Trans. Ent. Soc. Lond.*, 1908, p. 122.

‡ Dr. T. A. Chapman has seen *C. edusa* select yellow leaves to rest upon. *Proc. Ent. Soc. Lond.*, 1904, p. lxxvi.

§ *Trans. Ent. Soc. Lond.*, 1906, p. 97-106.

towards the sun. For shortness of expression I described a butterfly so placed as "oriented." The butterflies observed were for the most part Satyrines and Nymphalines, and the observations were made in Northern India, Algeria and South Africa, as well as in England. Without pledging myself to any explanation of this habit, I was inclined to attribute it to the diminution of its shadow when the orienting butterfly closed its wings, whereby the insect was rendered very inconspicuous.

To the number of orienting butterflies previously given may now be added the Neotropical Nymphalines, *Precis lavinia*, Cram., *Anartia jatrophae*, Linn., *A. amalthea*, Linn., *Victorina stelenes*, Linn., and *Cystineura dorcas*, Fabr.

The details, taken from my note-book, follow:—

Constant Spring, Jamaica, 8 January, 1907. *Precis lavinia*, Cram., f. *zonalis*, Feld. Not uncommon, but hard to catch; usually settled on the ground with wings open; seen to orient and to put its wings up, causing little shadow; also to adjust itself after settling, so as to make the orientation more perfect; but also seen to face the sun.

Maraval, Trinidad, 19 December, 1906. *Anartia amalthea*, Linn. Flies near the ground; settles with wings three-quarters open; orients, but not always.

Same place and day. *Anartia jatrophae*, Linn. Has a ghostly flight; settles on the ground; orients.

Colon, Panama, 28 December, 1906. *A. jatrophae*. This species orients, but not very regularly.

Constant Spring, Jamaica, 3 January, 1907. *A. jatrophae*. Orients, but not very accurately; often closes its wings, and is then very cryptic among whitish dead grass.

Same place, 5 January. *A. jatrophae*. The commonest Nymphaline: flies fast, close to the ground, looking very white. Usually settles on the ground or close to it; does not frequent flowers much; settles with the wings fully expanded, but often closes them over its back. Orients, but not accurately. Has however been noted with its wings up facing the sun; also once or twice across the sun.

Ramble, Jamaica, 24 January, 1907. *A. jatrophae*. Orients.

Montego Bay, Jamaica, 2 February, 1907. *A. jatrophae*, seen twice to settle on the whitish sand of the sea-

shore, to orient and close its wings, making no shadow.

Port Antonio, Jamaica, 4 March, 1907. The sun nearly vertical. *Victorina stelenes*, Linn., settled on leaves, once facing the sun, once head downwards, tail to the sun, wings closed and no shadow.

Ramble, Jamaica, 24 January, 1907. *Cystineura dorcas*, Fabr. Flies very slowly, close to the ground. Settles with wings nearly wide open, but it sometimes closes and then quickly re-opens them. When feeding on flowers, especially the Composite, *Bidens leucanthus*, W., it is indifferent as to its position with regard to the sun, but otherwise it usually orients, though it occasionally faces the sun.

Observations in Ceylon, 1908.

Precis iphita, Cram. This species was often observed. It most often settled with its wings closed, but frequently they were fully expanded. Though one specimen was seen to settle twice across the sun, it more usually either faced the sun or turned its tail to it.

Ypthima ceylanica, Hew. Ceylon. This species, which keeps close to the ground, settled occasionally with the wings open, more often half open, but most commonly closed. As regards orientation, it was noted to have its tail to the sun 10 times (once by adjustment), as against 7 times that it was across the sun.

Ergolis taprobana, Westw., and *E. ariadne*, Linn. May be conveniently taken together. They have a skimming or gliding flight which is not always checked by rain. They settle commonly with their wings fully expanded, but sometimes close them only to open them again. Most often they orient, but sometimes imperfectly; one was seen to adjust itself.

Nissanga patnia, Moore. This butterfly settled with its wings up (one exception) and so far as I observed with the eye-spot exposed. In the majority of cases it oriented.

Neptis jumba, Moore; *N. varmona*, Moore; and *Rahinda sinuata*, Moore. These three species may be conveniently taken together. They all have the same gliding flight and all settle most frequently with the wings fully expanded, though often closed. As regards orientation less than half the specimens observed appeared to pay any

attention to the direction of the sun's rays, though one *varmona* was certainly seen to adjust its tail to the sun.

Castalius rosimon, Fabr. Two specimens seen to orient with wings up.

Some English Satyrines.

I have previously recorded my experience * that in the great majority of cases *Pararge ægeria*, Linn., and *P. megæra*, Linn., settle with their wings expanded and with their tails pointed towards the sun, though occasionally both species sit across the sun, but even in that case with wings expanded.

The following note may be added:—

Mortehoe, 14 September, 1907, late afternoon. *P. megæra* found asleep upon the face of a rock, about 3 ft. above ground: its head up, antennæ porrected but separated; wings in close contact; fore-wings drawn back so that no fulvous colour was exposed.

Epinephele tithonus, Linn.

The following observations show that the habits of this butterfly, as regards orientation, are similar to those of *Pararge megæra*.

Mortehoe, 20 July, 1906. *E. tithonus*. A specimen observed settled across the sun, with wings closed.

Same place and day. Another specimen seen to settle twice; oriented, with wings open.

Mortehoe, 11 August, 1907. A specimen settled on the ground, oriented, wings three-quarters open.

Mortehoe, 15 August, 1907. A specimen settled on grass; across the sun, wings closed. It was disturbed by a ♂ *E. janira*, it settled again and this time oriented and closed its wings, making no shadow.

Same place and day. A ♂ settled on a leaf, oriented wings open.

Same place and day. A ♂ seen to settle three times on leaves, with wings open; twice it faced the sun and then partially adjusted itself; the third time it oriented correctly.

* Trans. Ent. Soc. Lond., 1906, pp. 98, 99.

- Same place and day. A ♂ settled on grass, oriented, wings half to fully open.
- Same place and day. A ♀ on a bramble leaf, oriented, wings three-quarters to fully open: it was twice observed to close its wings leaving little shadow; the eye-spot on the fore-wing was exposed.
- Same place and day. A ♂ on a leaf of *Heraeleum*, wings three-quarters open, oriented; it momentarily closed its wings, leaving no shadow.
- Same place and day. A ♂ on a bramble leaf, oriented, wings three-quarters open.
- Same place and day. A ♂ on a bramble leaf, wings quite open, imperfectly oriented.
- Same place and day. A ♀ twice seen settled across the sun, wings closed, but eye-spot visible.
- Mortehoe, 22 August, 1907. A ♀ oriented, wings three-quarters open.
- Mortehoe, 24 August, 1907. A ♂ half-oriented.
- Same place and day. A ♀ on a leaf, imperfectly oriented.

Epinephele hyperanthus, Linn.

This is a restless butterfly, and takes long to settle; however, I have this note:—

Mortehoe, 20 July, 1906. Four *E. hyperanthus* seen to orient, with wings three-quarters open.

§ 10. "List" and Shadow.

In my paper on some Rest-attitudes of Butterflies, I gave instances of Satyrine butterflies which usually close up their wings when settled and have a habit of then leaning over to one side. This I termed a "list." The object of the manœuvre appeared to be to aid concealment, but my first observations were imperfect in the important respect that the direction of the list, whether towards or away from the sun, was not recorded. The fact of listing was observed by me in India and Japan, and by Dr. Dixey and myself in England and South Africa.*

To the "listing" butterflies I am now able to add, from my own observations, a Neotropical species, also belonging to the *Satyrinæ*.

* Trans. Ent. Soc. Lond., 1905, pp. 135, 136; also 1906, pp. 109-111.

Calisto zangis, Fabr.

This is quite a shade-loving butterfly; it keeps close to the ground flying amongst herbage, usually for a very short distance at a time. It was once seen flying freely on a rainy day.

Mackfield, Jamaica, 29 January, 1907. Three *C. zangis* seen to settle (one of them twice) with a list away from the sun of about 30° (from the vertical).

Christiana, Jamaica, 2 February. *C. zangis* seen to list away from the sun.

Mile Gully Mt., Jamaica, 14 February. *C. zangis* seen to settle and then, with a jerk, list about 30° .

Port Antonio, Jamaica, 4 March. Three *C. zangis* seen to list from the sun, usually but 20° – 30° ; one was seen to increase the list in two movements.

During my visit to Ceylon in the spring of 1908 I did not see any butterflies list.

Cænonympha pamphilus, Linn.

Early in June 1906 Mr. W. J. Kaye told me that he had recently noted in Surrey the common *C. pamphilus* settle with its wings up, but leaning over in such a way that the sun's rays fell vertically upon its wings. Going down to Devonshire the next day I naturally wished to confirm Mr. Kaye's observation, but though I have seen the butterfly in some abundance at Morteohoe its appearance there is most uncertain, so much so that neither in 1904 nor in 1907 did I come across a single specimen in the parish! However, in 1906 I did succeed in finding three specimens which I observed with the following results.

Morteohoe, 10 June, 1906. *C. pamphilus*: a specimen seen to settle six times; always across the sun; with head sometimes to the right, sometimes to the left; the wings up; in every case with a list away from the sun so that its rays were about normal to the wing surface.

Morteohoe, 13 June, 1906. A specimen seen to settle several times; across the sun; the wings up, but with no list.

- Mortehoe, 14 June, 1906. A specimen seen to settle 16 times; always with wings up and across the sun; on 12 occasions with a list away from the sun.
- Braunton Burrows, 10 Sept., 1907. *C. pamphilus* (the only one seen that year) settled across the sun, with head to the wind, and a list away from the sun.
- Morte Point, 5 September, 1908. *C. pamphilus* rather common at one spot; the wind was so strong as to compel them to keep their heads to it regardless of the sun. A specimen was seen to list three times to the right, slightly, and once to the left, strongly.

Satyrus semele, Linn.

The behaviour of this butterfly may be compared with that of the last-named.

- Mortehoe, 20 July, 1906. A number of *S. semele* observed to settle. All put their wings up; two oriented with tail to sun; one faced the sun; 24 placed themselves across the sun, of these one was noted as listing about 30° towards the sun, but eight listed away from the sun, only one however to an extreme degree.
- Same place and day. Three *S. semele* put into a large glass-covered box. Observed the same afternoon, at 6 p.m., in sunlight; all three were sitting across the sun and listed away from it 35° , 45° , and 55° respectively.
- Mortehoe, 31 July, 1906. Several *semele* noted, settled across, and tilted a *little* away from the sun.
- Mortehoe, 22 August, 1907. Three *semele* observed at rest, all across the sun and listed away from it 30° , 40° , and 25° respectively.
- Lundy Island, 27 August, 1907. A *semele* listed away from the sun about 50° .

Here I may insert an observation made by Mr. E. G. Waddilove at Bournemouth in the autumn of 1906:—

“A grayling settled on a patch of bare black peat-earth, shut up its wings vertically and crawled at once some two yards to the edge of the patch to where some fir-needles, a cone or two, and a few brittle twigs were lying, and then becoming stationary threw itself over at an angle of some 45° square to

the sun. It thus became quite indistinguishable from its surroundings." (From a letter to the author.)

The late Mr. C. G. Barrett, in an admirable account of the habits of the same butterfly, wrote as follows:—

" . . . it even seems to lie down sideways, or at any rate to so greatly slope its closed wings as to appear prostrate."*

Epinephele janira, Linn.

The case of our commonest butterfly is especially interesting, since its habits are irregular and partake of those of *C. pamphilus* and *S. semele*.

Mortehoe, 20 July, 1906. *E. janira*. Four specimens oriented; of these, 3 had the wings open, 1 closed. Eleven specimens were settled across the sun, with wings closed; certainly one of the latter listed from the sun.

July 30. Some noticed to orient; others sitting across the sun.

Mortehoe, 11 August, 1907. 1 ♂ and 2 ♀ oriented; wings three-quarters open. Others seen across the sun and one of these listed. The wind was however this day too strong for trustworthy observations. The butterflies mostly sat head to the wind.

Mortehoe, 15 August, 1907. Several specimens noted settled on grass, on or near the ground. Of these 3 ♂ oriented, 1 with the wings quite open, the other 2 three-quarters open. A ♀ oriented with the wings open; another ♀ settled on a leaf oriented with the wings three-quarters open. Another ♀ sat across the sun, had its wings up, and listed away from the sun. The eye-spot on the fore-wing sometimes obscured, sometimes in part visible.

Mortehoe, 16 August, 1907. A ♀ seen to settle three times across the sun, with its wings closed, leaning away from the sun. Yet another ♀ was seen to settle three times; twice across the sun, with wings closed, but on the third occasion with its wings open and fairly oriented.

* "Lepidoptera of the British Islands," 1893, vol. i, p. 35.

Mortehoe, 22 August, 1907. A ♀ observed to settle three times, (1) oriented; (2) across, with slight list away from the sun; (3) oriented.

August 24. A ♀ settled on a leaf oriented.

The effect of a list on the shadow.

It is worth while carefully considering the precise effect of a list on the shadow of a butterfly sitting with the axis of its body at right angles to the sun's rays.

To make the matter clear I have constructed three diagrams. The diagrammatic butterfly is in each case

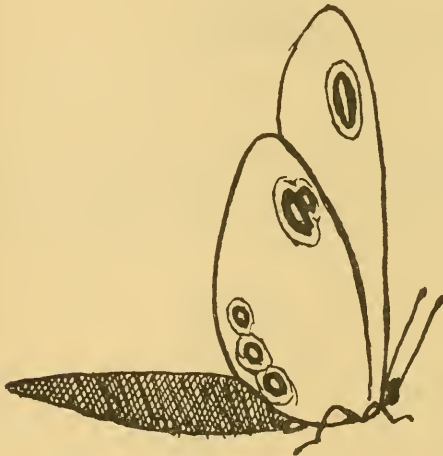


DIAGRAM A.

Butterfly upright, sun's elevation 50°.

supposed to be settled with its tail towards the observer, but turned somewhat to the left so as (in two of the three diagrams) to expose the underside of the right wings obliquely to the observer. The sun is supposed to be to the right of the observer and nearly to the right of the butterfly. The sun's elevation is taken to be 50°, representing a condition of affairs that is fulfilled in Europe during some part of every day near midsummer, and in the tropics during some part of every day in the year.

When the butterfly is upright its shadow is nearly as long as its wings, moreover its shadow is fully exposed to view. (See diagram A.)

If the butterfly were to list towards the sun its shadow, still fully exposed to view, would diminish until the list were equal to the sun's altitude, when there would be no shadow. In this position, moreover, its wing surfaces would be least illuminated.

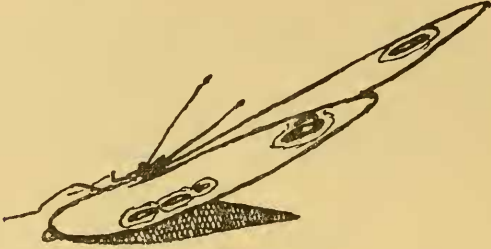


DIAGRAM B.
Butterfly listing, more than 60° towards the sun.

Supposing the butterfly to increase its list; this would bring the sun's rays on to the under surface of its left wings and so throw the shadow to the right, or towards the sun. (See diagram *B.*) The shadow would continue to

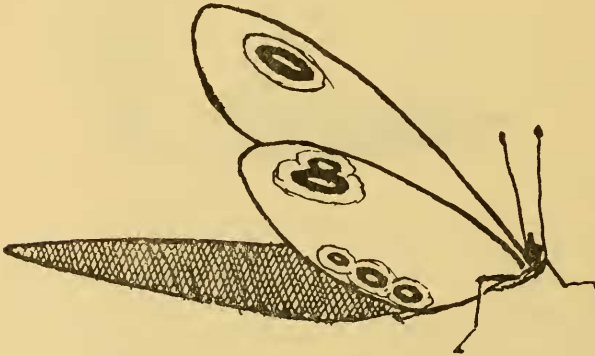


DIAGRAM C.
Butterfly listing, 40° from the sun.

increase in length until when the butterfly's wings touched the ground it would equal them in length. On the other hand, as the shadow increased in length it would be more and more concealed from view.

But as a matter of fact the list has almost always been observed to be *away* from the sun. Such a list increases

the length of the shadow until the list amounts to 40° (under the conditions assumed) and so brings the wings into a position normal to the sun's rays. (See diagram C.) The length of the shadow is then at its maximum and longer than the wings.

A further list will diminish the shadow until when the wings touch the ground it will equal their length.

A little consideration will, however, show that by listing the butterfly, so to say, covers up its own shadow more and more, so that while a slight list produces little effect on the shadow, a considerable list— 45° and upwards—makes the shadow less conspicuous than that cast by the same butterfly in the upright position.

My conclusion accordingly is that, so far as regards the shadow cast, no list *from* the sun can be protective to the insect unless it be extreme. Again, a list *from* the sun, by resulting in the maximum illumination of the wing surface, can hardly aid concealment. At the same time, it cannot be denied that a butterfly by placing itself out of the upright, may thereby be protected in so far as it may then be more difficult to detach it from its surroundings. This would certainly appear to have been the case with the *Melanitis* recorded by Col. Bingham* and by "E. H. A.," † also with the *S. semele* observed by Mr. E. G. Waddilove.

Dr. Chapman tells me that he has observed a marked list in a Spanish species of *Erebia*, and my own experience of list is confined to the Satyrines, a group of feeble fliers, be it noted, with (at any rate in the great majority of species) cryptic under-sides. I am, however, aware that Prof. Poulton and Mr. Rowland-Brown have observed an extreme list in *Thecla rubi*, Linn.; possibly connected with the green colour of the under-surface of its wings.‡

Barrett's remark as to a rarer British butterfly, *Grapta c-album*, Linn., deserves quotation:—

“. . . fond of sunning itself in roads, on warm walls, or on the ground upon dead leaves in sheltered valleys. Here if the sun becomes overclouded, it will sometimes close its wings and almost lie down, in such a manner that, to distinguish its brown and

* Trans. Ent. Soc. Lond., 1902, p. 363. See also "Butterflies of India," vol. i, p. 47.

† "A Naturalist on the Prowl," p. 203.

‡ Proc. Ent. Soc. Lond., 1906, p. xxviii.

green marbled underside from the dead leaves is almost impossible." * Here Barrett says *if the sun becomes overclouded*, but I have observed the list during bright sunshine only.

When my attention was first drawn to the subject of Heliotropism by observing the habits of *Pararge schakra*, Koll., in the Simla district in October, 1903, I was disposed to associate that habit with another—that of listing to one side or the other—and suggested that both had probably been selected since they appeared to assist to a notable degree in the concealment of the insect from its foes.†

The evidence now available is more ample though still far short of what would be requisite in my opinion to establish definitely any explanation.

Prof. Parker's explanation that by negative Heliotropism the insect displays its colouring to the best advantage, can scarcely be applied to list, for while it may be true that by listing a butterfly displays its under-side, that under-side is in listing butterflies usually cryptic, even when in our cabinet it appears the more brilliant of the two. Moreover, in the listing position the most conspicuous feature of the pattern is often concealed by the hind-wing.

That under special circumstances there is an "economy of shadow" in both heliotropic and listing butterflies is unquestionable. On the other hand, the negatively heliotropic butterfly with wings expanded, and the listing butterfly with wings closed, both place their wings as nearly as may be normal to the sun's rays, exposing in the one case their upper, in the other their under, surface. Is it possible that the direct rays of the sun falling normally on either surface of the wings, afford a pleasurable sensation to the insect? Or is the exposure of the insect's *body* to the sun, common to some extent to both these attitudes, the end obtained? The obvious love of most butterflies for hot and sunny corners unquestion-

* *Op. cit.* p. 125.

† Mr. Marshall writes to me that he has observed in the case of three S. African butterflies, *Precis cebrene* and *Hamanumida dædalus*, at Salisbury, and *Mycalesis campina*, Auriv., in Chirinda forest, that when they have been sunning themselves they have closed their wings with a snap when a heavy cloud has passed over the sun.

ably suggests some such explanation. Perhaps the two explanations may both be true, that heliotropism and list combine the pleasures of insolation with the minimum of risk.* It must, however, be remembered that the listing butterfly exposes to the sun *one* hind-wing only, and a small portion of one fore-wing.

§ 11. *The inverted attitude of Lycænids and some other Butterflies.*

Supplementing the observations recorded in my paper on "Some Rest Attitudes of Butterflies" † I may add the following notes:—

North Devon, 1 September, 1907. Walking with Mr. H. Champion along the Woolacombe Sandhills late in the afternoon we observed 39 specimens of *Lycæna icarus*, Rott., asleep on Marram, Privet, etc. No less than 38 of these were sleeping with the head down, while the exceptional one was horizontal. In many cases the fore-wings were drawn so far back that the costæ of the hind-wings overlapped those of the fore-wings. The antennæ were porrected and near together.‡

Mortehoe, 11 September, 1907. A ♀ *L. icarus* at rest on a Ragwort flower moved its hind-wings alternately.

* Mr. Marshall calls my attention to the fact that orienting butterflies are always very much on the alert, and do not need cryptic protection.

† Trans. Ent. Soc. Lond., 1906, pp. 106-9.

‡ In the fourth Report of the Rugby School Natural History Society, 1870, p. 17, is an interesting note by Mr. Arthur Sidgwick, which I give at some length as the Report is not easily accessible. "On the 13th August, 1870, I noticed on the road from Bex to Gryon, in the Rhone Valley, a large number of the Chalk-hill Blue (*Polyommatus Corydon*), on the umbelliferous plants by the roadside. It was just sunset, and they were all at rest. Their colour and shape effectually protected them from notice. . . . I noticed that they all rested *head downwards*. It occurred to me that even this apparently trifling detail of instinct or habit might be protective. The eye in wandering over a plant is arrested more easily than one would suppose by any outline *out of accord* with the general lines on which the plant is constructed." The note is accompanied by sketches showing that the butterfly resting head downwards is less conspicuous than one in the opposite position.

Carácas, Venezuela, 3 March, 1907. The dingy little *Catochrysops hanno*, Stoll., was seen sitting head downwards, opening its hind-wings at intervals.

Walderston, Jamaica, 16 February, 1907. *Calycopis pan*, Drury. The lobe of the hind-wing is everted as in *Aphnæus*, *Argiolaris*, etc.

St. Ann's, Trinidad, 1 April, 1907. A ♀ of *Thecla spurius*, Feld., seen sitting head down; the hind-wing is folded; the lobe is large.

The Zebra-like *Thecla linus*, Sulz., is a common species in Trinidad. The lobe of the hind-wing is everted, but not quite to a right angle; it is curious that the tails are *crossed*, so that the tail of the right-wing imitates the antenna of the left side and *vice versa*. Mr. Knight has made this very clear in the figure.



FIG. 1.

Thecla linus at rest : (a) natural size ; (b) the lobe enlarged.

The tails were seen to move slightly, and the "false head" looked more like a head than the real one. Though I have no note to that effect, I feel sure that I saw this species sitting head downwards.

My recent Ceylon experience (Jan.-March, 1908) enables me to add 9 more species, in which I have observed the inverted attitude, making in all 19 species of *Lycænidæ*. It seems probable that sufficient observations are alone required to prove the habit to be general in that family.*

* Compare Trans. Ent. Soc. Lond., 1905, pp. 85, 86, 127. Mr. Marshall writes : "I am quite satisfied that this (head down) is the usual position in *Lycænidæ*, and could add numerous species to your list, such as : *Aphnæus*, *Spindasis*, *Axiocerces*, *Iolaus*, *Stugeta*, *Hypolyæna*, *Mimacræa*, *Nyrina*, etc., etc., but the simplest way is to mention the species which do *not* do it. Of these I know three only in South Africa : viz. *Alæna nyassæ*, *A. amazoula*, and *Pentila*

Zizera otis, Fabr., f. *indica*, Murray. ♀. One observation.

Everes parrhasius, Fabr. ♀. Two observations.

Nacaduba atrata, Horsf. ♂. One observation.

N. noreia, Felder. One observation.

Jamides bochus, Cram. ♀. One observation.

Lampides elpis, Godt. ♂. Two observations: in one case it settled head upwards, but turned round immediately.

Lampides celeno, Cram. 10 ♂, 1 ♀.

Polyommatus bæticus, Linn. Both sexes. Nine observations.

Surendra quercetorum, Moore. ♀. One observation.

Loxura arcuata, Moore. One observation.

The "sawing" movement of the hind-wings observed at Kallár in the Nilgiris in 1904 in *Lampides* sp., and in *Tarucus telicanus*, Lang, at East London, S. Africa, in 1905, was again observed in several Blues in Ceylon in 1908, viz. :—

Telicada nyseus, Guér. Six observations.

Everes argiades, Pall. Two observations.

Lampides celeno, Cram. Three observations.

Polyommatus bæticus, Linn. Six observations.

Poulton explains this movement* as assisting in the deception of the "false head," but the explanation scarcely satisfies me since butterflies at rest do not usually move their antennæ. It is however possible that movement as movement may challenge attack; compare the case of the Maina mentioned above.†

As regards the lobes on the hind-wings of so many Lycænids the following facts may be noted as supplementary to previous papers.‡

Aphnæus (Spindasis) vulcanus, Fabr. Ceylon, 1908.

tropicalis—all distasteful species. Similarly this is the normal position in South African *Nymphalinae*, viz. *Atella*, *Lachnoptera*, *Hypanartia*, *Precis*, *Catacroptera*, *Crenis*, *Charaxes*, *Euralia* and *Salamis*, which are all the genera I can think of at the moment in which I have actually observed it. On the other hand, all the *Danainæ* and *Acræinæ* hang with wings down. It is possible this may prove to be a good criterion of palatability, for the head-down position gives the insect a much better opportunity of launching into a rapid flight, and thus evading attack, which is not of such great consequence to distasteful species."

* "Essays on Evolution," 1908, pp. 282, 325, and the references there given.

† p. 630.

‡ Trans. Ent. Soc. Lond., 1905, pp. 85, 86; also 1906, pp. 106-109.

In this species, which has a habit of curvetting rapidly about before settling on the ground, the lobes, which are small, are everted. The hind-wings are folded in such a way as to make a very slight convexity between the two tails, the nervures corresponding to the latter lying in re-entrant angles.

Rapala lazulina, Moore. Ceylon, 1908. The lobes are everted.

Loxura arcuata, Moore. Ceylon, 1908. This species has a peculiar darting flight. The arrangement of the wings at rest is somewhat complicated: the lobes, which are small, are $\frac{1}{2}$, or perhaps $\frac{3}{4}$, everted, showing an eye-spot when the insect is looked down upon from above; the long tails appear to be somewhat twisted—one overlying the other, their black and white tips curved upwards. The

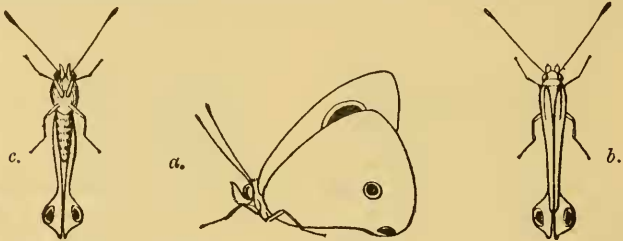


FIG. 2.

Calisto zangis at rest: (a) side view, (b) from above, (c) from below.

portion of the hind-wing between the extremity of the abdomen and the lobe is bent inwards. As touching the very nearly allied Indian species, *L. atymnus*, Cram., I noted at Calcutta in 1903, "its wings are much plaited longitudinally, and when at rest its extremely long tails, crumpled look, and brown colour give it quite the appearance of a dead leaf."*

Neither the inverted attitude nor the everted lobe would appear to be confined to the *Lycænidae*, as the following examples prove.

The common Jamaican Satyrine, *Calisto zangis*, Fabr., has a peculiarity of construction which appears significant. The anal angle of the hind-wing is somewhat produced, moreover on either under surface, at the angle, there is a small ocellus. When at rest the wings are raised over the back in the usual manner; the abdomen is covered by the

* Trans. Ent. Soc. Lond., 1905, p. 90.

hind-wings, which are folded closely under it, but the anal prolongation of the wing is everted at right angles, as in the lobed Lycænids, and as in their case the ocellus may be seen from above. In every case in which I noted the butterfly at rest it was upon the ground, so that I do not know whether it ever adopts the inverted attitude and is protected by a "false head." But whether that be so or not the approach to Lycænid structure in a Satyrine is interesting.

At first I thought that the eversion of the lobe in *C. zangis* might be due to the pressure of the curved surface of the pill-box in which the butterfly was confined, but subsequently was abundantly convinced that such is not the case, for when the butterfly rests on a flat surface with which the wing does not come in contact it is everted just the same.

There is a well-developed lobe in the Oriental and Ethiopian Nymphaline genus *Cyrestis*, while the allied Neotropical genus *Megalura* has a somewhat similar structure (pointed out to me by Prof. Poulton), but I am not aware that the bionomic significance of these has as yet been worked out.

The fine large blue-grey Nymphaline *Peridromia feronia*, Hübn., is a strong flier, which has the unusual habit of settling upon tree-trunks, usually choosing palms with silvery-grey stems. The butterflies harmonise wonderfully with the silvery-grey stems as they sit with wings fully expanded like Geometers, but always *head downwards* as noticed by Darwin in Brazil.* When disturbed they will return to the same tree again and again. I met with this species at Colon, La Guaira and Trinidad, and noticed these points on each occasion.

Another large Nymphaline which appears invariably to sit head downwards is *Aganisthos orion*, Fabr., of which I saw several in Jamaica. The favourite resting-place seemed to be the trunk of a logwood tree, *Hæmatoxylon campeachianum*, Linn., from 1 to 4 feet from the ground. This species rests with its wings closed above its back, and although the underside is cryptically coloured, the butterfly may be seen from a considerable distance when in profile.

* "Journal of Researches," etc., edn. 1860, p. 33. Compare W. J. Burchell's observations (1825—1836), quoted by J. C. Moulton, *Ann. Mag. Nat. Hist.*, Ser. 8, vol. ii, August 1908, pp. 184-7.

The pretty little Nymphaline *Dynamine theseus*, Feld., which I was familiar with in Venezuela, Trinidad and Tobago, often reminded me of a Lycænid in its rapid flight and other ways; thus I several times saw it settle head downwards and then quickly move its wings, though I was not able to get near enough to make out the exact nature of the movement.

§ 12. *The Rest-Attitudes of certain Neotropical and Oriental Hesperids.*

The attitudes assumed by the following Skippers are doubtless familiar enough to many who have seen them



FIG. 3.

Eudamus proteus at rest: (a) side view, (b) from above.

alive, but nevertheless I think it worth putting them on record, more especially since even such excellent illustrations as those of Plötz represent these insects at rest in positions that they never assume.

Eudamus proteus, Linn. The rest-attitude of this common species, as seen in Jamaica, is very striking. It was noted to rest with all the wings up, but partly open and with the fore-wings much sloped back. At the same time the conspicuous tails remain horizontal, nearly at right angles to the wings; for a great part of their length they overlap, but their extremities are divergent. If Mr. Knight's drawings do not represent this attitude quite as clearly as I should have liked, it is because I was not able

to supply the artist with adequate material. The tails appear to be an impediment to the insect's flight.

The three following species, *Hesperia syrighthus*, Linn., *Anastrus simplicior*, Möschl., and *Ephyriades otreus*, Cram., all rest with the wings fully expanded.

On the other hand, *Carystus coryna*, Hew., and *Catia drurii*, Latr., rest with all the wings up; in the case of the latter the fore-wings are much sloped back. The only specimen of the former that it has been my good fortune to see alive was resting on a mass of silvery-white schist or gneiss which shone in the sun with the same metallic gleam as its "silver-washed" under-side.*

Cymænes silius, Latr., was noted in Tobago to settle with the hind-wings horizontal, the fore-wings raised.

In four species I have noted that the fore-wings (which are somewhat ample) are convex upwards as in our English *Thanaos tages*, Linn., these are: *Gorgythion begga*, Prittw.; *Cycloglypha thrasybulus*, Fabr.; and *Chiomara gesta*, H.S., all met with in Venezuela, and *Systacea crosa*, Hübn., in Jamaica.

Mr. Meyrick includes our *malvæ* and *tages* in the genus *Hesperia*; but the difference in the form of the fore-wings is very obvious during life, as is the difference in the resting attitudes, and the distinctions seem to me to have generic value.

I have noted the folding of the hind-wings in the following Ceylon Hesperids:—*Telicota bambusæ*, Moore; *Parnara mathias*, Fabr.; *Bibasis sena*, Moore, and *Badamia exclamationis*, Fabr.†

Two of the above-named rest with the fore-wings erect, the hind-wings erect, or nearly so, and all the wings much sloped back:—*Parnara mathias* and *Badamia exclamationis*.

The following Ceylon species settle with their wings fully expanded like Geometers:—*Tagiades obscurus*, Mab. (*distans*, Moore); *Caprona (Pterygospidea) ransonetti*, Feld.; *Hantana infernus*, Feld.; *Celænorrhinus (Plesioneura) spilothyrus*, Feld. Of these the two last certainly settle on the under-side of leaves; they are neither of them so swift of flight as many of the family, and there is no doubt whatever that the habit greatly aids the concealment of somewhat conspicuous insects. When in Ceylon previously,

* Entom. Month. Mag., 1908, p. 120.

† Compare Trans. Ent. Soc. Lond., 1906, p. 112.

in 1904, I saw *spilothyrus* thus settle, and in the same year in India saw *ransonnetti* do so.*

Though perhaps somewhat out of place I append the beautiful drawing made by Mr. H. Knight (from my sketch and specially set specimens) to illustrate the very peculiar attitude adopted by the common Jamaican Uraniid, *Sematura ægistus*, Fabr. The hind-wings are somewhat fluted, as in *Pararge ægeria*, Linn., the anal angle of the hind-wings is *inverted*, not everted as in the Lycænids. One might naturally suggest as a possible explanation a procrptic resemblance to a dead leaf, but



FIG. 4.

Sematura ægistus at rest, viewed from behind.

the only specimens that I have seen at rest were inside houses whither they had been attracted by light.

§ 13. *Seasonal Dimorphism in Neotropical Butterflies.*

Seasonal Dimorphism has long been a subject of study in the Oriental and Ethiopian regions, but in the Neotropical world comparatively little attention has been paid to it.† A visit of less than four months, and those within the limits of the winter, or dry-season, affords but little opportunity for the investigation of such a difficult question—and the difficulty is increased by the paucity of cabinet specimens bearing adequate data—nevertheless I venture to offer the results of my observations for what they may be worth.

In the Old World we see in certain genera of the Satyrines that the same species exhibit two forms, characterised by the presence or absence of ocelli on the under surface of the hind-wings. Similarly two forms are met with in the Nymphaline genus *Precis*‡; in the one ocelli on the under side of the hind-wings are well de-

* For the similar habit of *Pterygospidea (Tagiades) fesus*, Fabr., in S. Africa, see Trans. Ent. Soc. Lond., 1907, pp. 323, 330.

† See *Dixey*, Proc. Ent. Soc. Lond., 1898, p. xxxix.

‡ Including *Junonia*.

veloped, but in the other they are rudimentary or entirely absent. With the absence of ocelli is often associated a more angulated form of the wings, which are sometimes tailed, while the whole under surface is often of a redder colour, and the insect when at rest is cryptic, sometimes resembling a dead leaf. Again, in many Pierines there are also two forms, the one characterised by the black markings on the upper surface being more pronounced and sometimes by a suffusion or irroration of black scales; whereas in the other form there is an irroration of reddish scales on the under surface, with or without reddish or purplish markings.* Now these two forms have long been recognised as occurring for the most part in the Wet and Dry seasons respectively, though it must be admitted that in the case of *Terias* and *Catopsilia* the correspondence is not nearly so close as in *Mycalesis*, *Precis* and *Teracolus*. However, for convenience these are usually spoken of as "Wet-season forms" and "Dry-season forms," or even for shortness as "Wet" and "Dry."

When at rest, with wings closed above its back, the Dry-season insect is usually more cryptic than the Wet, resembling in some instances red soil, in others a dead or discoloured leaf. It is notable that the Dry-season form is commonly more marked in the female sex.

If among Neotropical butterflies similar pairs of forms are met with, I propose provisionally to speak of them as "Wet" and "Dry," and then to inquire to what extent they are found in the corresponding seasons of the year.

Calisto zangis, Fabr. (Jamaica). Although there is some variation in the size of the ocelli on the under side of the wings in my specimens, I am unable to divide them into seasonal forms.

Euptychia hermes, Fabr., *camerta*, Cram. In the Wet-

* In *Catopsilia*, *Callidryas* and *Ixias* the disco-cellular spots on the under side of both fore- and hind-wings are usually larger with larger white centres and altogether more conspicuous in the dry season. Moreover, in *Ixias* dry-season specimens have on the under side of the hind-wing a series of reddish, or purplish, post-discal spots, which when fully developed have white centres (especially in *I. pyrene*), and call to mind the similarly placed ocelli so well known in the Wet-season forms of *Mycalesis* and *Precis*, and indeed they are not unlike the rudimentary ocelli seen in "intermediate" specimens of those genera, though they never attain to the complicated "peacock-feather" pattern so characteristic of many *Nymphalidæ*.

season form the ground colour of the under-side is of a bluish-grey, the transverse lines are distinct and the ocelli well marked.

In the Dry-season form the ground colour is browner in tint, the transverse lines are faint and the ocelli are minute.

I give, in a tabular form, a statement of all the specimens that I took, divided into the three classes "Dry," "Wet," and "Intermediate." The specimens classed as intermediate I have attempted to divide according as they seem to approach nearer to one form or the other. Males and females are distinguished and the dates of capture given.

Euptychia hermes, Fabr., *camerta*, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad . .	...	...	♂	19 Dec.
Panama . .	...	...	♂	28 Dec.
Venezuela . .	♂ ♂ ♂ ♀ ♂	♂ ♀	♂ ♂ ♂ ♀	22-29 March.
Trinidad . .	...	...	♂ ♀	1 April
Tobago . .	...	...	♂ ♀ ♀ ♀ ♂	6, 7 April.
Trinidad . .	...	...	♂ ♂	12 April.
Totals. .	4 ♂, 1 ♀	1 ♂, 1 ♀; 4 ♂, 1 ♀	6 ♂, 5 ♀	

It is somewhat remarkable that the specimens from Tobago were all distinctly "Wet" though the country showed every sign of extreme drought. Here the distinction between the forms might be local and not seasonal; or, as I am disposed to think, a seasonal form may have become localised.

Precis lavinia, Cram. The nomenclature of this species is in great confusion. Messrs. Godman and Salvin brought together the various forms found in Central America under the name *cœnia*, Hübn., including what is generally known in the West Indies as *genoveva*, Cram. Mr. Guy A. K. Marshall has recently rearranged the genus *Precis* in the National Collection, and I am happy to find myself in complete agreement with one whose knowledge of the genus is so intimate. Cramer figured three forms, all from Surinam; a ♂ which he called *lavinia*, a ♀ which he called *evarete*, and a ♀ which he called *genoveva*. The last two I agree with Mr. Marshall in considering to be Dry- and Wet-season forms respectively. The insect is

extremely variable, in ground colour, in the size of the ocelli on the upper surface (especially the anterior ocellus on the hind-wing), in the presence or absence of a greenish gloss, or "glance," and in the presence or absence of a transverse white band on the fore-wings (*zonalis*, Felder). In some specimens from Guiana this white band is replaced by a purplish gloss. It is almost impossible to divide these varieties into local races since the various forms overlap considerably, and the most widely different forms are found in Mexico. However, speaking generally, it may be said that the form *cænia*, Hübn., prevails in the United States and northern Mexico, that the form *zonalis*, Feld. (*genoveva*, auctorum) prevails in the West Indies (approaching to *cænia* in the Bahamas), that the type form *lavinia*, Cram., of which the ♂ has a hind-wing with a green gloss, prevails in Brazil, a brown form in Peru.

But what does not seem to have been generally noticed is that all the numerous varieties are themselves dimorphic. That is to say, that (as in the Indian species of *Precis*) they may be divided, as regards the colouring of the under surface of the hind-wings, into (1) those with several ocelli, of which two at least are conspicuous, (2) those in which the ocelli are merely indicated by black dots, or are entirely wanting, and (3) individuals intermediate in this respect. Analogy with the East would lead one to call the first *Wet-season* forms and the second *Dry-season* forms.

Precis lavinia, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Barbados	♀	...	♂	19 Dec. 1906.
Mt. Hope, Panama	...	...	♂	28 Dec. 1906.
Constant Spring, Jamaica . . . .	...	♂	♂ ♀ ♀	31 Dec. 1906— 8 Jan. 1907.
Mandeville, Jamaica	♂	...	...	20 Jan. 1907.
Port Antonio ,,	...	♂	♂	25 Feb. 1907.
Constant Spring, Jamaica . . . .	♂	...	...	7 March 1907.
Panama City . . .	♀ ♀	...	♀	12 March 1907.
Carácas, Venezuela	♂ ♂ ♂	...	♀	19-28 March 1907.
St. Ann's, Trinidad	...	♂	...	1 April 1907.
Tobago	♂	♂	...	6-8 April 1907.
Total	7 ♂, 2 ♀	4 ♂	4 ♂, 4 ♀	

I brought home 21 specimens; of these 6 were taken between 18 Dec. and 8 Jan., 5 of them were "wet," only 1 "dry."

Fifteen were taken between 20 Jan. and 9 April; of these 8 were "dry," 3 "wet," and 4 intermediate.

As the dry season advanced the dry form more or less displaced the wet form.

Dated specimens in Mr. W. J. Kaye's collection taken in the wet season are mostly wet; the same applies to specimens in the Hope Collection. Judging from the condition of many of the specimens I met with, it is a long-lived insect and therefore considerable overlapping may be anticipated.

Anartia jatrophae, Linn. Two forms are fairly well marked:—

Wet-season. Under side. Ground colour nearly white; markings often conspicuously edged with scarlet. Ocelli black with blue centres. No transverse bar on hind-wing.

Dry-season. Under side. Ground colour shaded with grey; markings edged with ochreous or reddish-brown, ocelli often blue only, orange-ringed. Hind-wing with a transverse grey bar.

Anartia jatrophae, Linn.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad . . .	...	...	♂	19 Dec.
Panama . . .	...	♀	♀ ♂ ♂ ♂	28 Dec.
Constant Spring	♀ ♀ ♀		♂ ♂ ...	31 Dec.—5 Jan.
Mandeville . . .	♂	♂	♂ ...	20, 21 Jan.
Mackfield . . .	♂	♂	...	24 Jan.
Christiana . . .	♂	...	...	16 Feb.
Port Antonio . .	♀ ♀	♀ ♂	...	24 Feb.—4 Mar.
Panama . . .	...	...	♂	12 March.
Trinidad . . .	...	...	♂	1 April.
Tobago . . .	...	...	♂ ♂ ♂	4-5 April.
Total . . .	3 ♂, 5 ♀	3 ♂, 2 ♀; 3 ♂, 1 ♀	9 ♂	

The table would appear to point to the forms being local rather than seasonal. The "dry" specimens, it will be observed, were all taken in Jamaica and were all of the race, or sub-species *jamaicensis*, Möschler,* but, on the other hand, not all the *jamaicensis* were "dry."

* See "Butterflies taken in Jamaica," Trans. Ent. Soc. Lond., 1908, p. 44.

Callidryas eubule, Linn. The two forms are abundantly distinct, more especially in the male sex.

Dry form. ♂ *Under side.* Hind-wing, and all exposed part of fore-wing, irrorated with red-brown; the markings strong; stigmata clearly outlined.

♀ *Under side.* As in male but reddish irroration darker.

Wet form. ♂ *Under side.* No irroration: brown markings very faint; stigmata faintly outlined.

♀ *Under side.* Reddish irroration very faint.

Intermediate specimens are frequent, approaching now one, now the other form.

It may be at once admitted that these two forms of *C. eubule* are not restricted to the respective seasons to anything like the extent that is observed in the case, *e. g.*, of the S. African *Precis octavia*, Cram., and its "dry" form *P. sesamus*, Trim. Thus on 12 Jan., 1907, *C. eubule* was seen in numbers flying about a weedy field at Temple Hall, on the road between Constant Spring and Castleton, Jamaica. Three examples were secured; a female of well-marked "dry" and one of equally well-marked "wet" type, whereas the third, a male, may be described as "intermediate, inclining to wet." I was informed that there had been no rain for three weeks.

Callidryas eubule, L.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.	
Barbados . . . .	...	♀ ♀	♂ ♂	18 Dec. 1906.	
Trinidad . . . .	...	...	♂	19 Dec. 1906.	
Savanilla, Colombia	...	...	♂ ♂	22 Dec. 1906.	
Cartagena ,,	...	♀	♂	23 Dec. 1906.	
Colon, Panama . .	...	...	♂	28 Dec. 1906.	
Constant Spring, Jamaica	♀	♂	♂ ♂	♂ ♀	1-9 Jan. 1907.
Castleton, Jamaica .	♀	♂	♂	♀	11-12 Jan. 1907.
Mackfield ,,	♂ ♂ ♂ ♂	♀	♀	...	25-27 Jan. 1907.
Montego Bay ,,	♂ ♀ ♀	♀ ♂	...	...	4-5 Feb. 1907.
Walderston ,,	♀ ♀	♀	♂	...	7-18 Feb. 1907.
Spanish Town ,,	♀	...	♂	...	21-22 Feb. 1907.
Port Antonio ,,	♂ ♂	♂	...	...	3-5 Mar. 1907.
Constant Spring, Jamaica . . . .	...	♀	...	...	7 Mar. 1907.
El Valle, Venezuela	...	♂ ♂ ♀	...	...	26-27 Mar. 1907.
Zigzag ,,	...	♂	...	...	29 Mar. 1907.
Tobago . . . .	...	♂ ♂ ♀ ♀ ♂ ♂ ♀	♂ ♂ ♀	...	3-10 Apr. 1907.
Totals	7 ♂, 7 ♀	14 ♂, 12 ♀	12 ♂, 3 ♀		

It will be observed that (as we found in the case of *A. jatrophae*) no distinctly "dry" specimens were taken out of Jamaica. There is also evidence (very ambiguous in the case of Tobago) that the "dry" form tended to displace the "wet" as the season advanced.

I had also the advantage of examining Mr. W. J. Kaye's series of this insect. Of six specimens taken in Jamaica in the month of August (wet season) 5 are of the "wet" form, 1 of the "dry." Of two specimens taken in Trinidad in July, one is "wet," the other "intermediate," another taken in September is also "intermediate." A specimen taken in British Guiana in either November or December is "wet."

These facts are fairly in accord with the theory that the dimorphism is seasonal in the case of *C. eubule*, especially if due allowance be made for the fact that the insect has the appearance of being long-lived.

Terias euterpe, Mén. (Jamaica). My 60 specimens exhibit but very trifling differences that can be set down to possible seasonal dimorphism.

The specimens that I am disposed to regard as exhibiting Dry-season coloration may be distinguished by the following characters on the *under surface*.

The reddish-orange edging of the wings is more conspicuous. The hind-wings are irrorated with purplish-brown scales, and the purplish markings (especially the borders of the apical pink patch) are more conspicuous.

I do not give the results as set out in the following table with much confidence, and the division of the "intermediate" specimens into those inclining rather to wet or to dry respectively should not carry much weight. Subject to these limitations, it will be seen that the specimens considered as "wet" were commonest at the two extremities of the period, those considered as "dry" prevailed throughout the first half of February.

Terias euterpe, Mén. (Jamaica).

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring	♂ ♂	♂ ♀	♂ ♂ ♂ ♂ ♀	31 Dec.—4 Jan.
”	...		♂ ♀	8-10 Jan.
Castleton . . .	♀	♂ ♂	♀ ♂	11-12 Jan.
Mandeville . . .	♂ ♀ ♀ ♂	♂ ♂ ♂	...	17-22 Jan.
Mackfield . . .	♂ ♀	♂ ♀ ♀ ♂ ♂ ♂ ♂ ♂	♀ ♂	24-27 Jan.
” . . .	♀	♂ ♀ ♀ ♀ ♂ ♂	♂	29 Jan.—2 Feb.
Montego Bay . . .	...	♀	...	4 Feb.
Walderston . . .	...	♂ ♀	♂	8-14 Feb.
Christiana . . .	♂	♂ ♂	...	16 Feb.
Walderston . . .	♀	♀ ♂	♀ ♀	18 Feb.
Port Antonio . . .	...	♂ ♀	♂	25 Feb.—1 Mar.
Constant Spring	...	...	♂	7 March.
Total . . .	6 ♂, 6 ♀	20 ♂, 10 ♀; 5 ♂, 2 ♀	7 ♂, 4 ♀	

Terias delia, Cram. (Jamaica, N. Coast of S. America).

The extreme “seasonal” forms are quite distinct.

♂ UPPER SIDE.

Wet-season.

Ground pale yellow; costa broadly black; longitudinal black stripe broad.

Dry-season.

Ground full yellow; costa faintly grey; longitudinal black stripe narrower.

♀ UPPER SIDE.

Wet-season.

Ground white; costa broadly grey.

Dry-season.

Ground of fore-wing pale yellow extending to costa.

♂ UNDER SIDE.

Wet-season.

Uniformly white.

Dry-season.

Hind-wings and costal three-fourths of fore-wings yellow irrorated with brown.

♀ UNDER SIDE.

Wet-season.

Fore-wing white; border pale yellow; hind-wing pale yellow irrorated with grey.

Dry-season.

Fore-wing yellow, its tip and all hind-wing pinkish-orange irrorated with darker.

Terias delia, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Savanilla, Colombia	...	♀	♂	22 Dec. <i>F. lydia</i> .
Colon, Panama . .	...	...	♂ ♂ ♂ ♂ ♀	28, 29 Dec. <i>F. lydia</i> .
Constant Spring, Jamaica	♂ ♂ ♀ ♀	♂ ♂ ♂ ♂ ♀ ♂	♂ ♂ ♂	1-8 Jan.
Castleton, Jamaica	...	♀	♂	12 Jan.
Mandeville , ,	♀	♂	...	22 Jan.
Mackfield , ,	♀ ♀ ♀ ♂ ♀	♂	♂	24-26 Jan.
Montego Bay, Jamaica	♀	...	♀	4 Feb.
Walderston, Jamaica	♀ ♂	...	...	12 Feb.
Port Antonio, Jamaica . . . .	...	♀	...	25 Feb.
Constant Spring, Jamaica . . . .	♀	...	...	7 March.
Ancon, Panama . .	♀ ♀ ♀	♂ ♂	...	11, 12 Mar.
Savanilla, Colombia	♀	...	...	15 March.
Carácas, Venezuela	♀ ♀	...	...	18-25 Mar.
Total	5 ♂, 16 ♀	8 ♂, 3 ♀; 1 ♀	10 ♂, 2 ♀	

An examination of this table shows clearly that the dry form got more prevalent as the season advanced, whereas the wet form disappeared. All the first 7 specimens, taken at Savanilla and Colon, 22-29 Dec., are of the form *lydia*, Felder. The last specimen taken, at Carácas, 25 March, is of the form *persistens*, Butl.

A male taken above Constant Spring, *c.* 1000 ft., on 1 Jan., another male taken a little to the west of Constant Spring, *c.* 500 ft., on 8 Jan., and a male taken near the railway at Panama on 12 March, all approach the form *lydia*, Felder, in having the longitudinal black streak broader than usual. On the other hand, the width of the streak in the form *lydia* varies considerably.

An aberrant male of the dry form taken on the foothills above Constant Spring on 1 Jan. is entirely without the black streak, the orange scales alone marking its position.

Terias elathea, Cramer (Jamaica, Venezuela), appears to be specifically distinct from *delia*, but is certainly very closely allied to it; the females are difficult to distinguish, and some specimens of the male sex not easily separable.

What I take to be the Wet form has the under side irrorated with grey; the Dry form with reddish.

Terias elathea, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring, Jamaica	♀ ?	...	♂	1, 2 Jan.
Montego Bay ,,	...	♂	...	3 Feb.
Port Antonio ,,	...	...	♂	3 March.
Carácas, Venezuela . .	...	♂ ♂	...	18-20 March.
Total	1 ♀	3 ♂	2 ♂	

In one of the Carácas specimens the black streak is very faint and might be described as obsolescent, in the other there is no trace of the black streak and scarcely any orange.

It will be observed that this aberration was in both species met with in dry, or somewhat dry specimens, but I scarcely think that it can be considered as the extreme dry form, at all events without more material.

Pieris phileta, Fabr., Jamaica, Venezuela, Tobago. In this species the seasonal differences are well known.

Wet-season form. Under side. Wings white, with but faint traces of yellow.

Dry-season form. Under side. Hind-wing and tip of fore-wing yellow; veins and lines in interspaces brown.

Pieris phileta, Fabr.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Montego Bay, Jamaica .	♂	...	...	4 Feb.
,,	...	♂	...	5 Feb.
,,	♀	
Walderston, Jamaica . .	♂	...	...	7 Feb.
,,	...	♂	...	
Venezuela . . . . .	...	...	♂	30 March.
,,	♂	
Tobago . . . . .	...	♂	...	10 April.
,,	♂	"
Total	2 ♂, 1 ♀	3 ♂	3 ♂	

Here again the forms seem to depend on locality more than season.

In case any one should desire to examine more closely into the matter I append notes on the weather conditions during the period in which I was collecting.

West Indies, etc., Meteorological Notes.

- 18 Dec. *Barbados*. End of Rainy Season: a shower that morning early. Much rain in November. "Christmas Winds" prevailing.
- 19 Dec. *Trinidad*. "Much rain lately": very wet season: rain that morning; ground wet.
- 20 Dec. *La Guaira*. Muddy streets and the appearance of much recent rain.
- 22 Dec. *Savanilla*. Woods very dry: run-to-seed.
- 23 Dec. *Cartagena*. A dry burnt-up look.
- 27 Dec. *Porto Bello*. Rain all day: also rain the day before.
- 28 Dec. *Colon*. Heavy shower this morning. Very heavy rain reported November and early December.
- 31 Dec. *Constant Spring*. No rain for three weeks: unusually cold at Christmas. Country very dry and run-to-seed.
- 7 Jan. *Constant Spring*. A smart shower.
- 15-16 Jan. " " Trifling shower in the night.
- 16 Jan. *Mandeville*. No rain for eight weeks: vegetation very dry.
- 19 Jan. *Mandeville*. Several showers: cloud most days.
- 21-22 Jan. *Mandeville*. Some rain in the night.
- 24 Jan. *Mackfield*. Reported to have been an exceptionally wet season: heavy rains November and up to 12 Dec.; nothing but trifling rain since; vegetation and soil very dry.
- 25 Jan. *Mackfield*. Rain afternoon and evening.
- 29 Jan. " Rain in early morning.
- 31 Jan. " Two heavy showers this afternoon.
- 2 Feb. *Montego Bay*. Heavy showers about four or five days before our arrival: before then no rain for a fortnight.
- 7 Feb. *Walderston*. No rain since 13 November, except trifling showers 3 Feb.
- 11 Feb. *Walderston*. Rain at dusk and early evening.
- 12 Feb. " Rain afternoon and evening.

- 13 Feb. *Walderston*. Wind and drizzle.
 15 Feb. " Slight rain in afternoon.
 16 Feb. " Heavy shower in afternoon.
 20-23 Feb. *Spanish Town*. Rain while we were there and several showers the previous week.
 24 Feb. *Port Antonio*. "No rain in January: some last week." Another informant, "Very dry up to the time of the earthquake (14 Jan.), frequent showers since."
 24 Feb.-5 Mar. *Port Antonio*. Rained nearly every day or night of our stay. Heavy rain 27 Feb.
 7 March. *Constant Spring*. "A good rain eight days ago, and other showers since the earthquake (14 Jan.); nevertheless everything looked very dry."
 11 March. *Panama*. Country very dry.
 20 March. *Carácas*. I was informed "last year was very wet, up to 25 Jan.; since then it has been our dry season, though there was some rain last week."
 21 March. *Carácas*. Heavy shower late afternoon.
 22 March. " Very heavy rain mid-day and afternoon.
 23 March. *Carácas*. Heavy rain mid-day and afternoon—many hours.
 29 March. *La Guaira*. The road down showed traces of heavy rain within a few days.
 4 April. *Tobago*. Everything very dry, but was informed that there had been "some nice showers at night during March."
 8 April. *Tobago*. Very heavy showers.
 12 April. *Trinidad*. Heavy rain.
 14 April. " A shower.

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